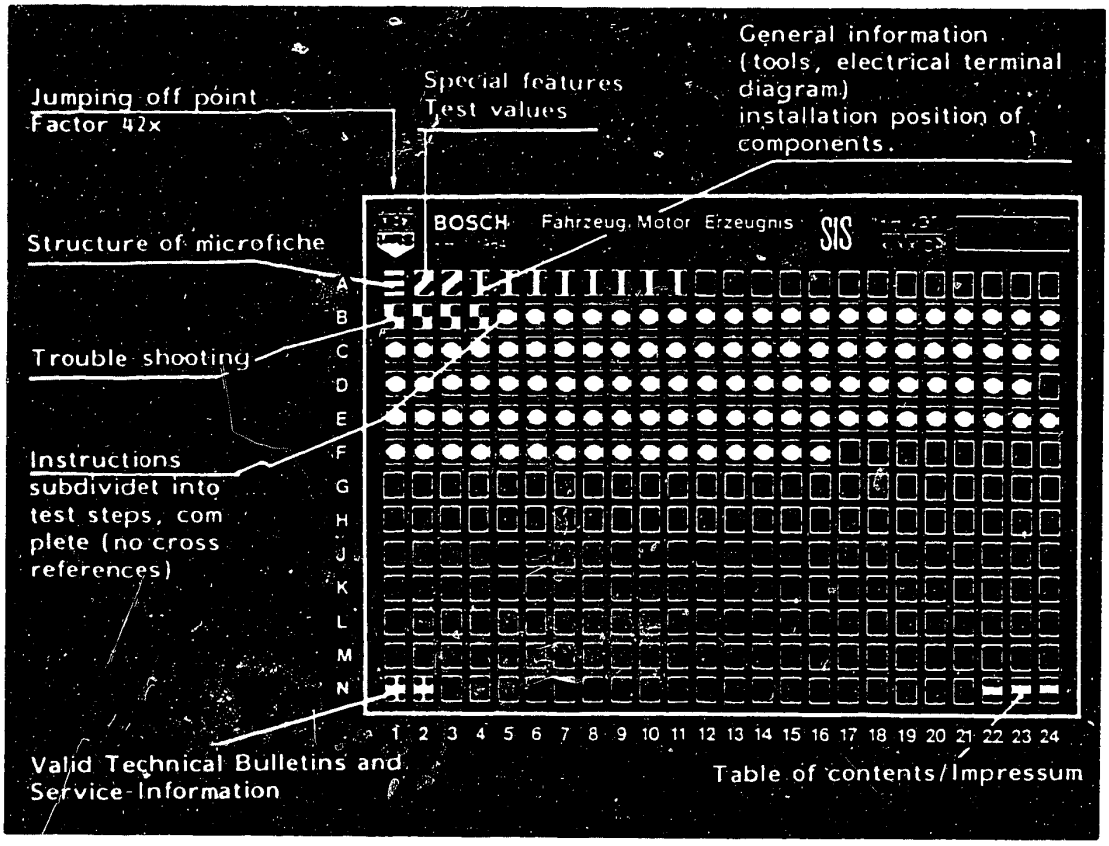
Structure of microfiche



1. Read from left to right
2. Title of microfiche (appears on each coordinate)

E16	Product/component/test step Vehicle/engine

Coordinate

3. Limits of section

Beginning Mid-section End One-page section

4. Purely vehicle-specific passages in the text are marked with a vertical bar.

5. Reference to relevant working steps in the test specifications, e.g. coordinate C6.

C6

1. Special features: Microfiche applies to following vehicles: Opel Rekord E/Vauxhall Carlton

2.0 D	9.77 - 10.82
2.1 D	9.77 - 7.78
2.3 D	8.78 - 10.82
2.3 D	11.82 →
2.3 TD	5.84 →

2. Test specifications

C9

2.1 Idle speed:
up to 8/83 650 ... 750 min^{-1}
as of 9/83 700 ... 750 min^{-1}

C10

2.2 Nozzle-opening pressure:

2.0 D, 2.1 D, 2.3 D up to 8/83	120 + 5 bar
2.3 D, 2.3 TD as of 9/83	135 + 8 bar

C17

2.3 Filter test
max. allowable differential pressure: 0.3 bar

D7

2.4 Compression loss: max. 25 %

F2

2.5 Injection timing:
Engine position: Cylinder 1 at TDC

Pump position:

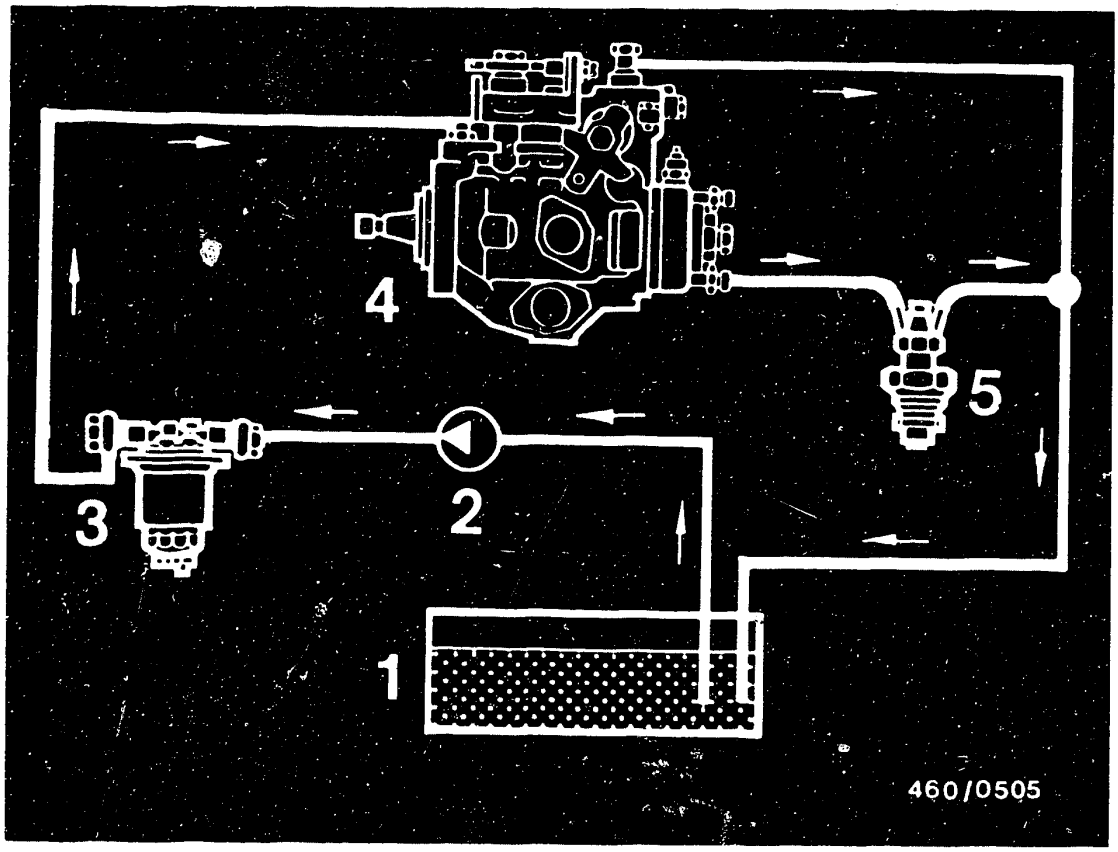
Engine type	VE-pump	mm after BDC
2.0 D	.. L 28	1.07 ± 0.05 (*1.30)
2.1 D	.. L 27	0.95 ± 0.05
2.1 D	.. L 12	0.88 ± 0.05
2.3 D	.. L 37	0.93 ± 0.05 (*1.24)
2.3 D	.. L 128	0.93 ± 0.05
2.3 TD	.. L 156	0.85 ± 0.05

* With modified timing-device cover

2.6 Compression pressure:	20...30 bar min. 17 bar
2.7 Charge-air pressure	0.75...0.80 bar

2.8 Tightening torques

Injection-pump pinion nut	55 Nm
Injection-pump fastening screws	25 Nm
Fuel lines	20 Nm
Screw plug	10 Nm
Sheathed-element glow plugs	40 Nm
Nozzle-holder assemblies	70 Nm

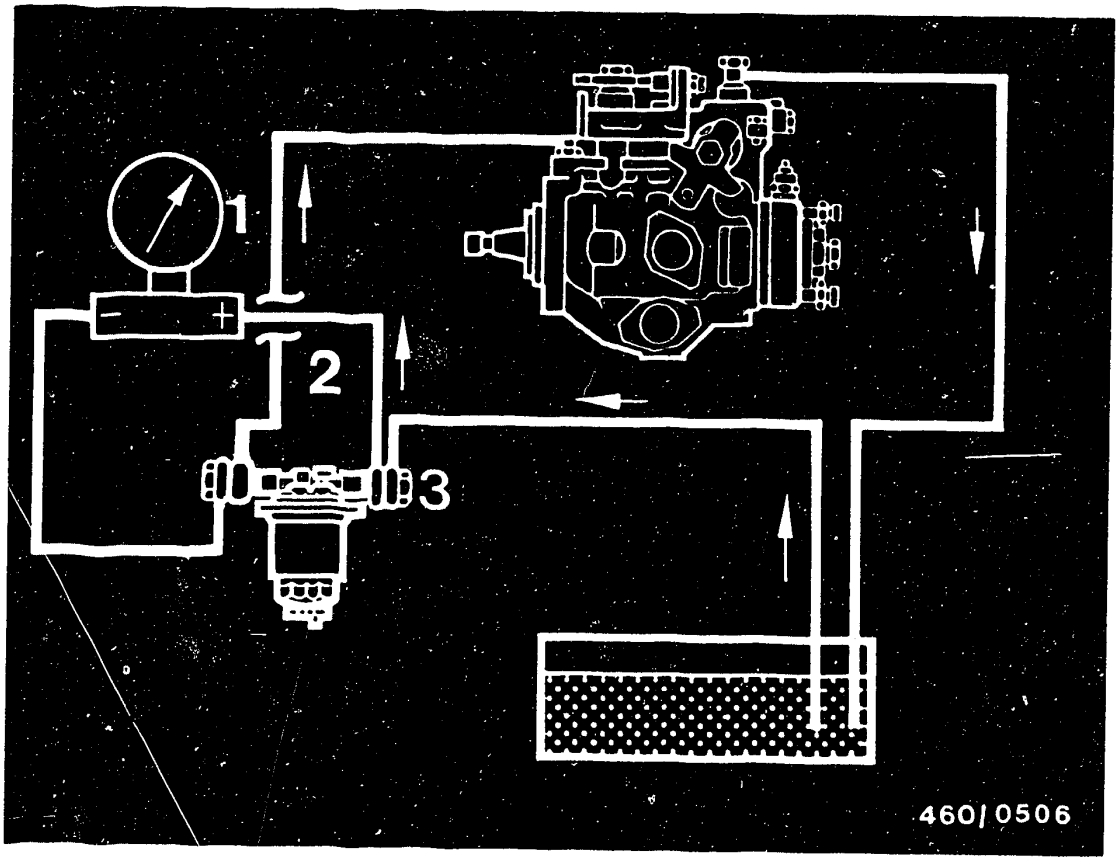


1 = Fuel tank
2 = Fuel pre-supply pump
3 = Fuel filter
4 = Distributor-type injection pump
5 = Injection nozzles

3. Connection diagram of fuel lines

The fuel lines are connected as shown in the above diagram.

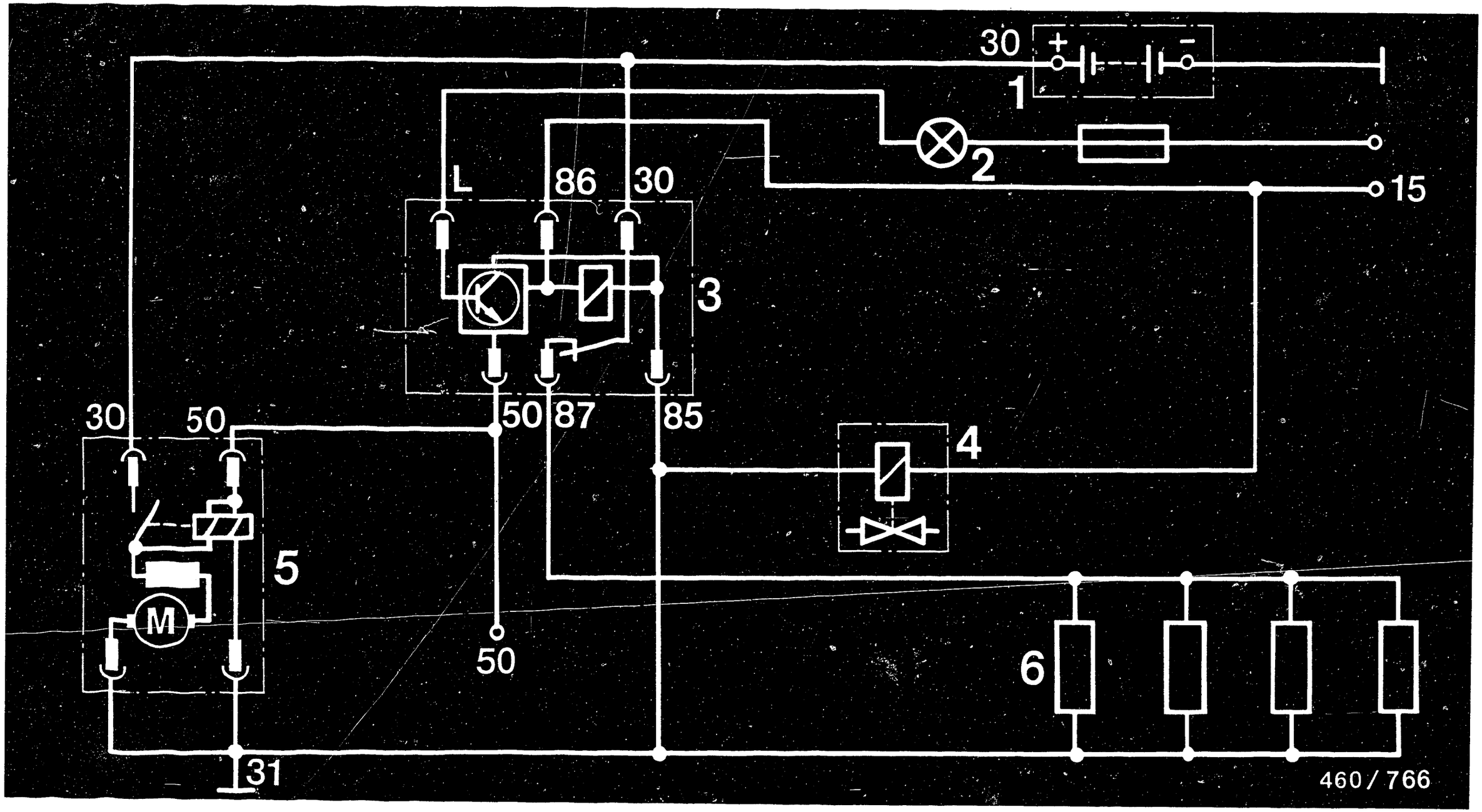
The fuel flows in the direction of the arrows.



1 = Differential-pressure gauge
2 = Filter outlet
(Use inlet union and extra-long inlet-union screw 2 443 456 020)
3 = Filter inlet
(Use inlet union and extra-long inlet-union screw 2 443 456 020)

3.1 Connection diagram for filter test

Connect differential-pressure gauge to fuel filter using appropriate connecting parts.



1 = Battery
2 = Glow-plug indicator lamp
3 = Glow-duration unit
4 = Solenoid-operated valve
5 = Starting motor
6 = Sheathed-element glow plugs

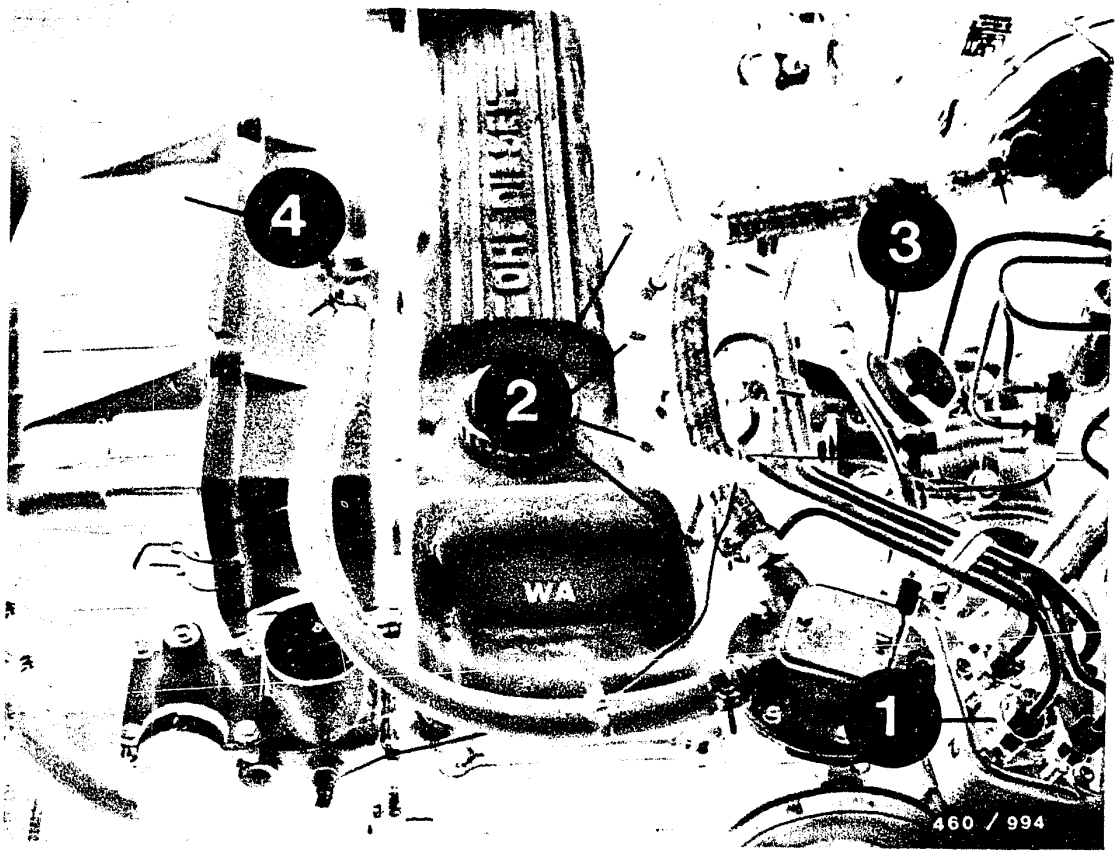
4. Connection diagram for preheating system

5. Test equipment and tools

Designation	Part Number	Use
Pressure tester or pressure gauge 0...1.6 bar	KDJE-P 100 e.g. Wika No. 4 184	Testing the charge-air pressure
Box wrench	KDEP 1115	Loosening/tightening injection lines
Measuring tool	KDEP 1126	Injection timing
Mini dial indicator 1/100 mm divisions	Commercially available e.g. Hahn & Kolb 7000 Stuttgart Part No. 33 003 with adapter KDEP 1127	Injection timing
Nozzle tester	EFEP 60 H 0 681 200 502	Testing the injection nozzles
Compression tester	Commercially available	Testing the engine compression
Compression-loss tester	EFAW 210 A 0 681 001 901	Testing the engine compression loss

Test equipment and tools (continued)

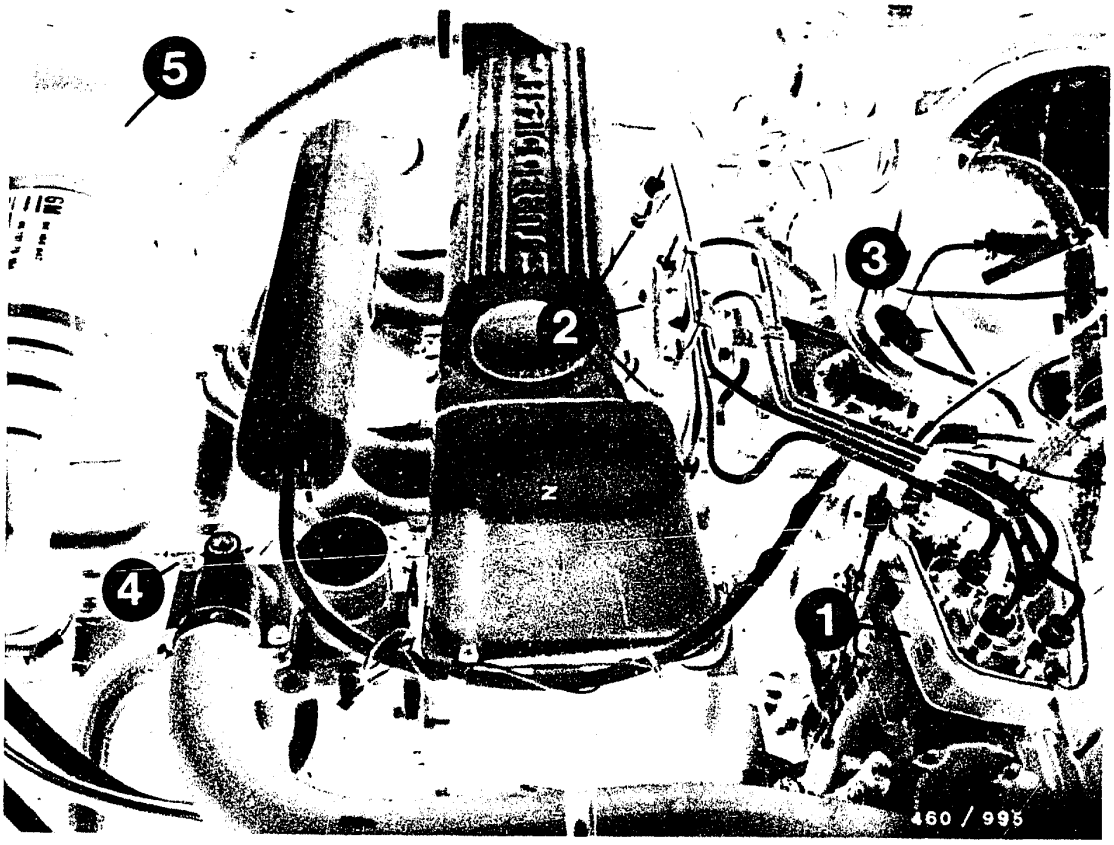
Designation	Part No.	Use
Tachometer	commercially avail., e.g., Dr. E.Horn GmbH Meßgerätefabrik Postfach 40 7036 Schönaich Part.dec.: HT 446 (with digital reading)	Adjusting engine speed
Differential-pressure guage	commercially available Part No. NG 160/311-911/ - 1.0 + 4.0 bar Firma Henni Nauheimerstr. 78-80 7000 Stuttgart 50	Filter test
Smokemeter Accessories box with proportion-ing unit	0 684 102 050 0 681 169 038	Smoke test



1 = Fuel-injection pump
2 = Injection nozzles
3 = Fuel filter
4 = Air filter

6. Installation position of components - Rekord E/Carlton

2.0 D (9.77 - 10.82)
2.1 D (9.77 - 7.78)
2.3 D (8.78 - 10.82)
2.3 D (11.82 →)



1 = Fuel-injection pump
2 = Injection nozzle
3 = Fuel filter
4 = Turbocharger
5 = Air filter

6.1 Installation position of components - Rekord E/Carlton

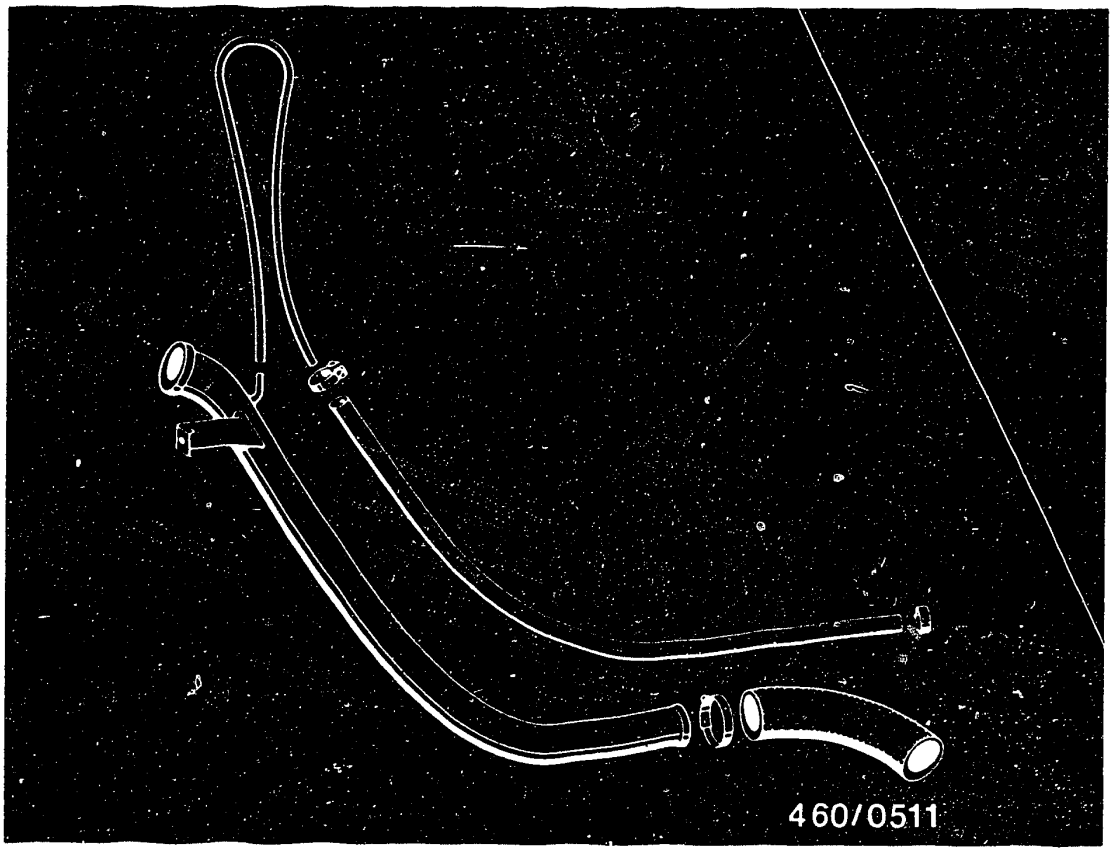
2.3 Turbo - Diesel (05.84→)

7. Trouble-shooting

Customer complaints (fault symptom)

1. Engine fails to start or starts only poorly when hot	2. Engine fails to start or starts only poorly when cold	3. Engine hunts when idling	4. Rough idling when engine hot	5. Engine missing during vehicle operation	6. Unsatisfactory performance	Cause (component fault)	Coordinates
●	●			●	●	Tank empty; tank vent clogged	B 5
	●					Cold-start accelerator not actuated	B 6
	●		●			Injection sequence does not correspond to firing sequence (check routing of fuel-injection tubing)	B 7
				●		Overflow restriction clogged	B 8
●	●					Shutoff device defective	B 9
		●		●	●	Inlet-union screws of inlet and return lines clogged (see diagram of fuel lines)	B 13
●	●		●	●	●	Air in fuel system	B 15
	●					Heavy parafin deposits in filter during winter operation (replace filter box)	B 18
●	●			●	●	Lines leaking or broken; connections loose	B 21
●	●			●	●	Supply lines clogged (check fuel lines)	B 24
●	●			●	●	Injection lines clogged or constricted (check fuel lines)	B 24
					●	Engine air filter clogged	C 1
			●			Idle speed incorrect	C 9
●	●		●		●	Injection nozzle defective	C 10
	●		●		●	Injection timing incorrect	F 2
●	●			●	●	Fuel filter clogged (differential-pressure test)	C 17
	●					Preheating system defective	C 20
					●	Timing device defective (remove injection pump)	D 6
	●		●			Engine compression poor or uneven	D 7
					●	Maximum speed incorrectly set (remove injection pump)	D 17
●	●	●	●	●	●	Injection pump (governor) defective or out of adjustment (remove injection pump)	D 17
					●	Check turbo charger for leaks and check charge-air pressure	F 8

7. Fuel consumption too high	8. Engine cannot be switched off	9. Rough engine running, black smoke in full-load range; possibly lack of power	10. Fog-like smoke in full-load range (white)	11. Incorrect engine speeds	12. Engine will not rev up when cold	13. Distributor-type injection pump overheating	Cause (component fault)	Coordinates
			●		●		Tank empty; tank vent clogged	B 5
					●		Cold-start accelerator not actuated	B 6
		●		●	●		Injection sequence does not correspond to firing sequence (check routing of fuel-injection tubing)	B 7
						●	Overflow restriction clogged	B 8
	●						Shutoff device defective	B 9
			●	●	●		Inlet-union screws of inlet and return lines clogged (see diagram of fuel lines)	B 13
			●		●		Air in fuel system	B 15
					●		Heavy paraffin deposits in filter during winter operation (replace filter box)	B 18
●							Lines leaking or broken; connections loose	B 21
			●		●		Supply lines clogged (check fuel lines)	B 24
			●		●		Injection lines clogged or constricted (check fuel lines)	B 24
		●					Engine air filter clogged	C 1
				●			Idle speed incorrect	C 9
		●					Injection nozzle defective	C 10
●		●	●		●		Injection timing incorrect	F 2
			●		●		Fuel filter clogged (differential-pressure test)	C 17
		●	●				Timing device defective (remove injection pump)	D 6
●					●		Engine compresssion poor or uneven	D 7
				●			Maximum speed incorrectly set (remove injection pump)	D 17
●	●	●	●	●	●	●	Injection pump (governor) defective or out of adjustment (remove injection pump)	D 17

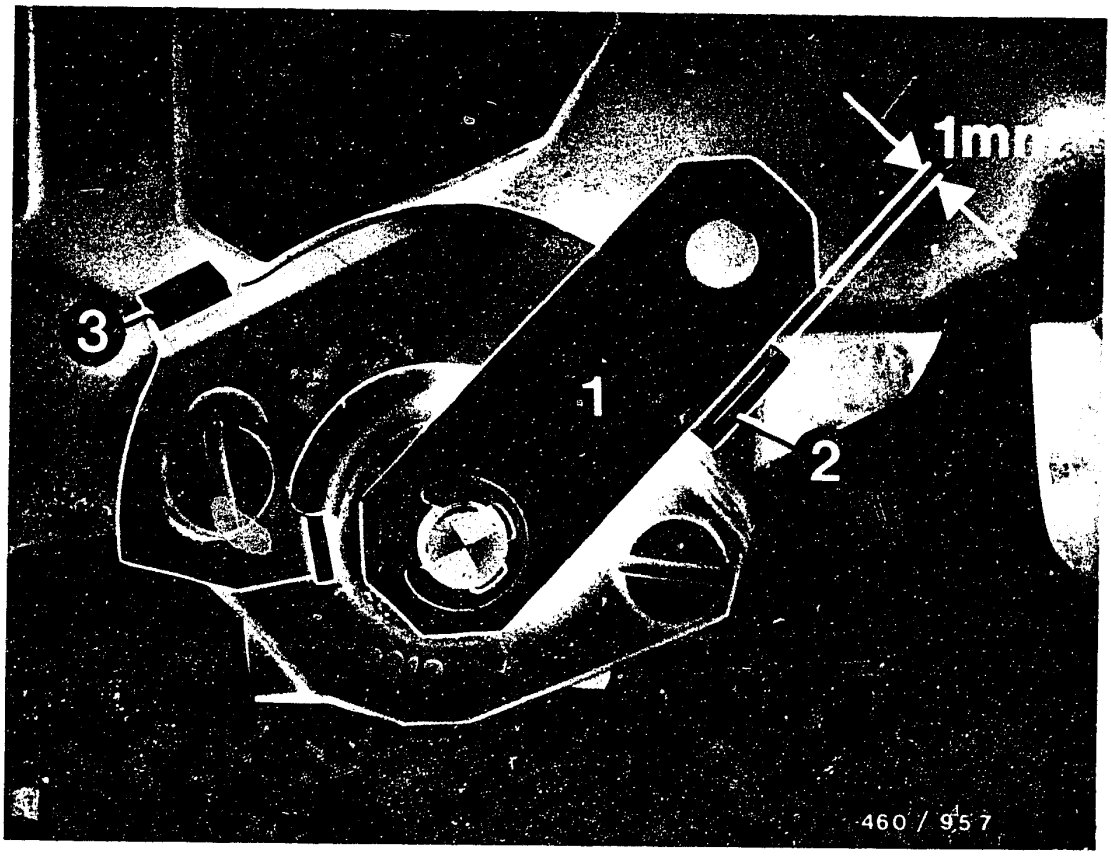


8. Check tank vent

Open filler cap.
If the fault disappears after opening the filler cap, the tank vent is defective.

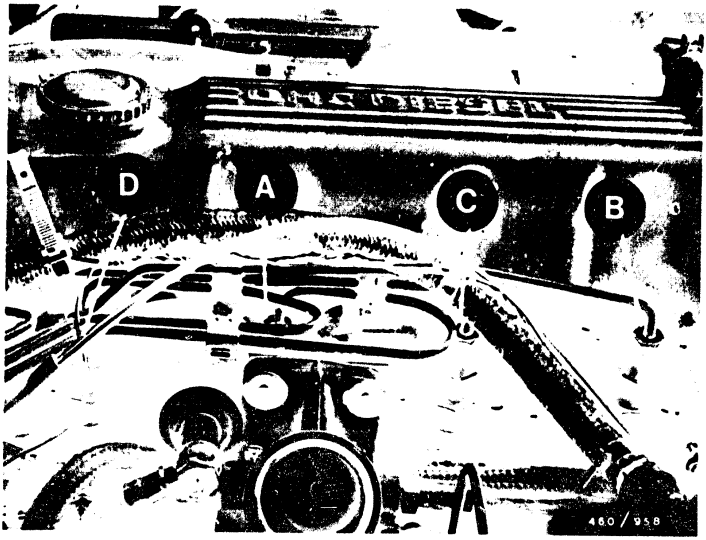
Remove tank vent hose lines (picture) and check for clogging and constriction.

If necessary, check fitting on tank.



9. Check operation of cold-start accelerator

Check whether, with the cold-start accelerator not actuated, there is a gap of 1 mm between control lever (1) and stop (2).
With the cold-start accelerator actuated, the control lever (1) must be up against the stop (3) (if necessary, adjust travel by means of bowden cable).

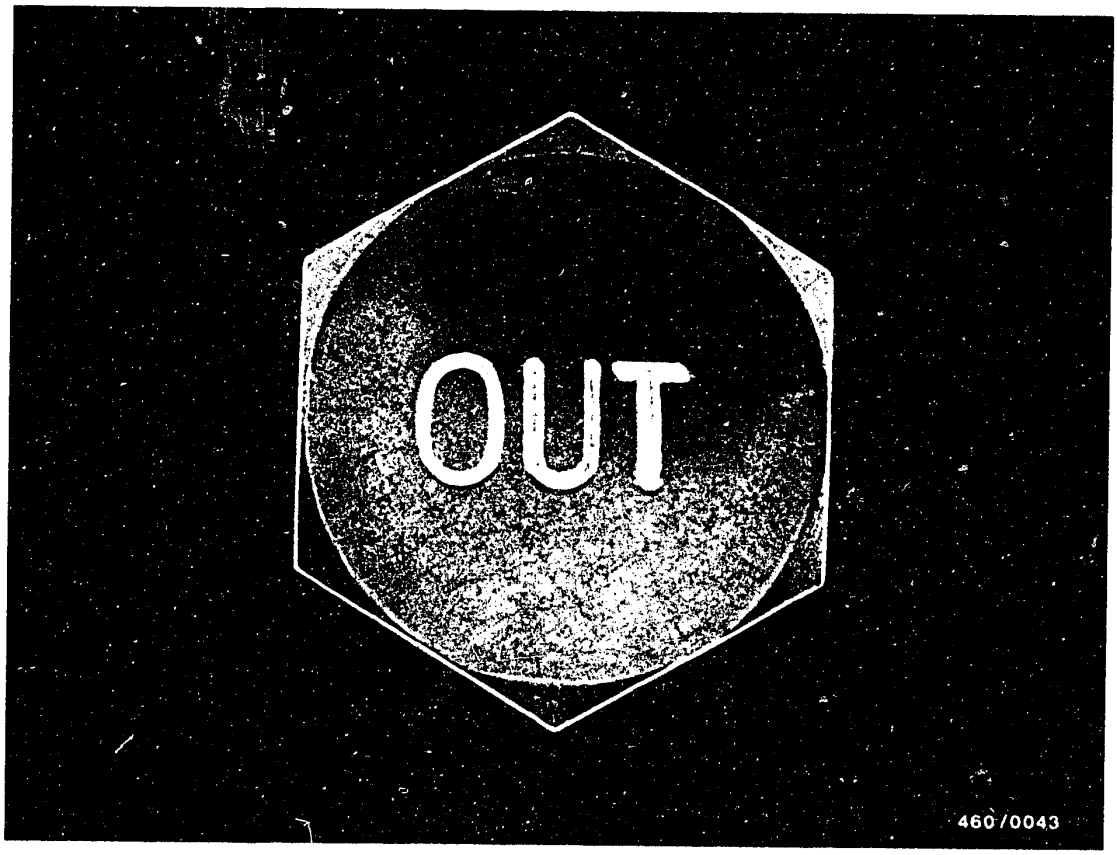


10. Check routing of fuel-injection tubing

The individual fuel-injection lines are held together by clamps so that it is impossible for the outlets to be mixed up.

If, however, there is any doubt, check the routing of the lines as shown in the picture above.

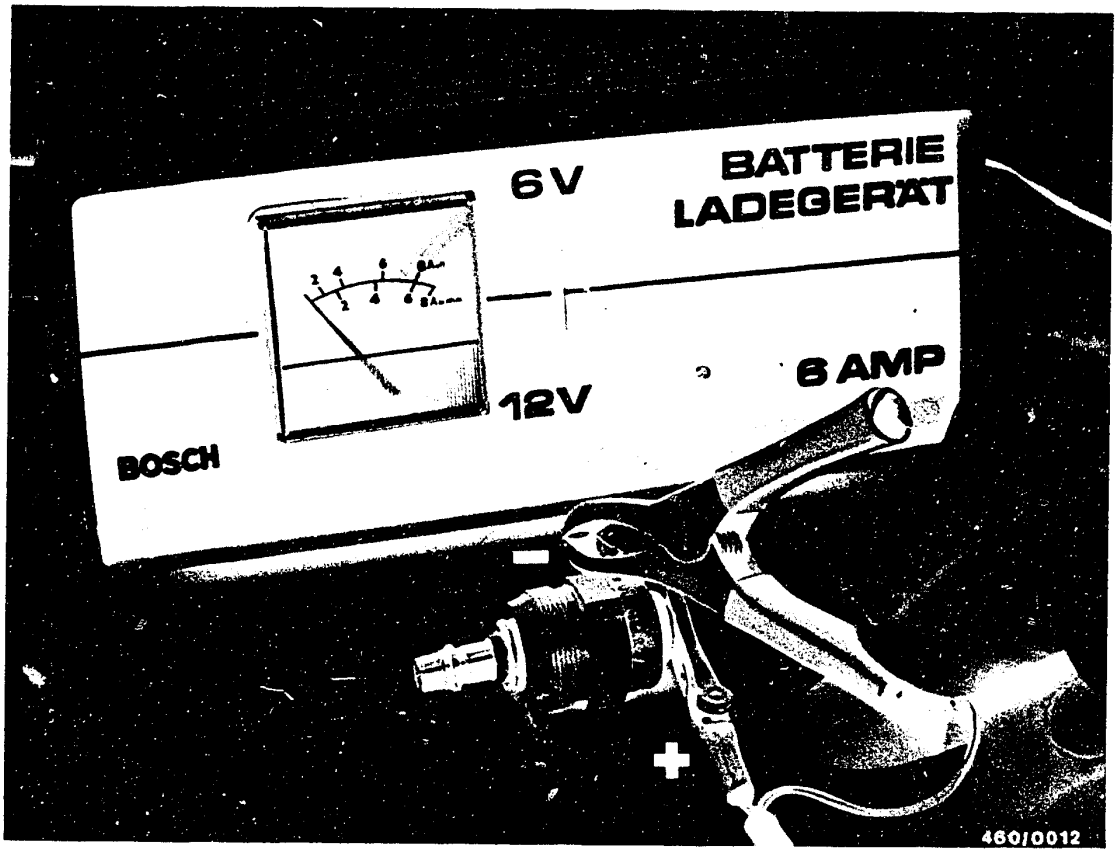
The pairing of the fuel-injection pump outlets with the individual engine cylinders is identified by the letters A...D (picture)



11. Check overflow restriction

Unscrew overflow restriction on fuel-injection pump (marked "out").

Perform visual inspection of wire screen for impurities. If in doubt, replace overflow restriction.



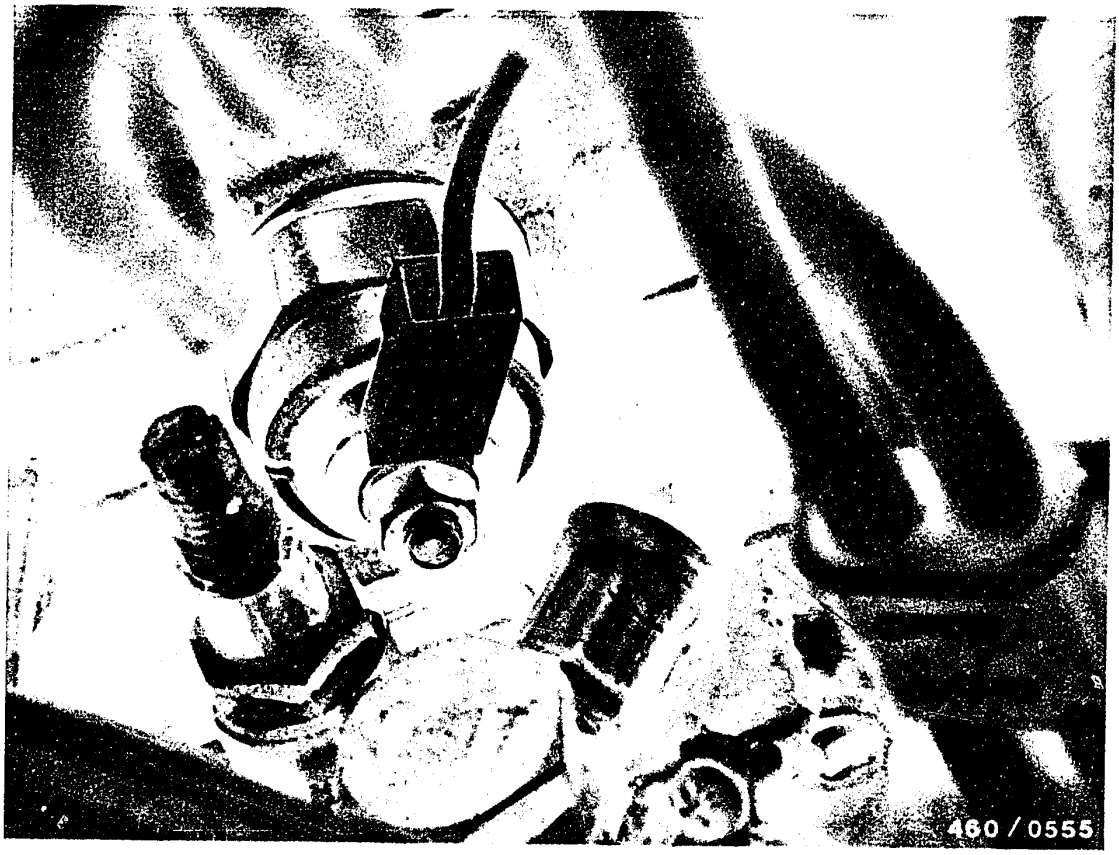
12. Check operation of shutoff device

12.1 Engine fails to start

Check whether solenoid-operated valve is supplied with voltage (min. 10 V) with glow-plug and starter switch switched on (drive position).
If voltage is present, remove fuel-injection tubing and take out solenoid-operated valve.
Cleanliness is essential.

When removed, check operation of solenoid-operated valve.

Note:
When removed, the solenoid-operated valve must only be supplied with voltage for a short period of time since it is no longer being cooled by the fuel.



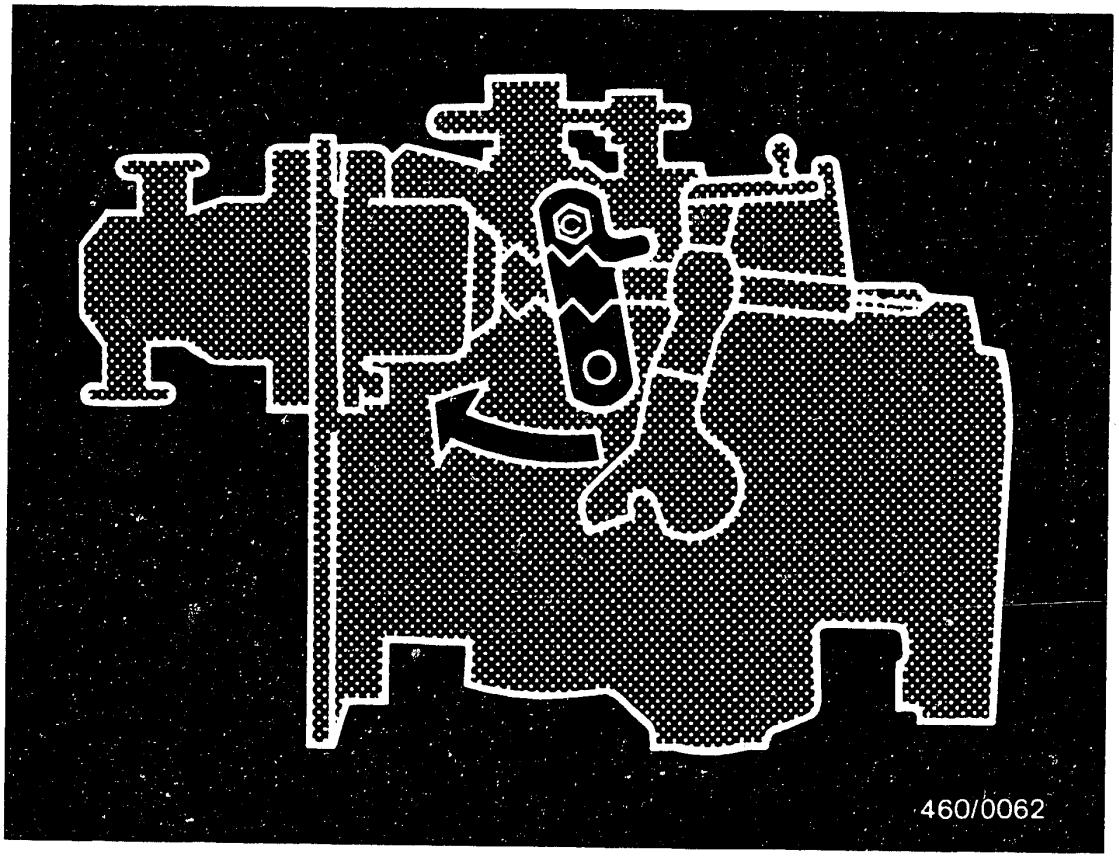
12.2 Engine cannot be switched off

With the glow-plug and starter switch in the stop position, there must be no voltage across the solenoid-operated valve, i.e. the fuel inlet at the distributor-pump plunger is interrupted.

If the engine continues to run although there is no voltage across the solenoid-operated valve, the engine can be switched off as follows:

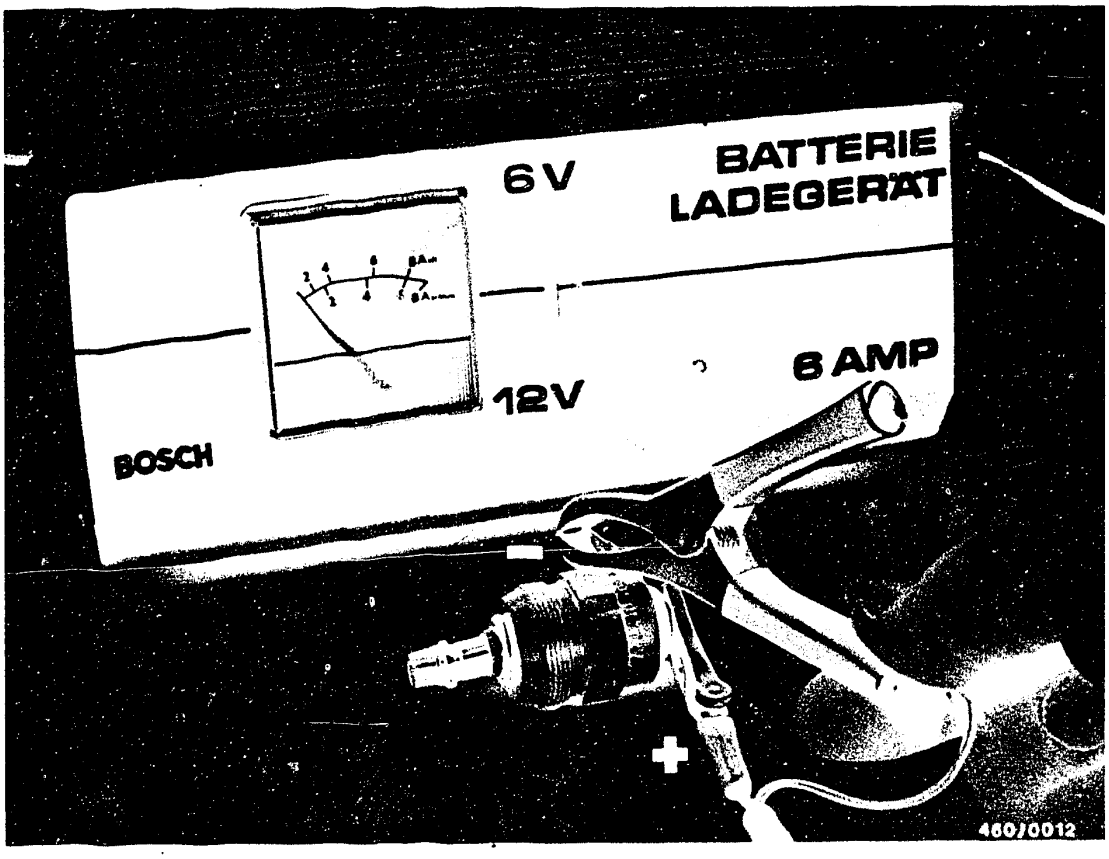
- Vehicles with manually-shifted transmission

Select 3rd or 4th gear.
Step firmly on foot brake and let out clutch.



- Vehicles with automatic transmission

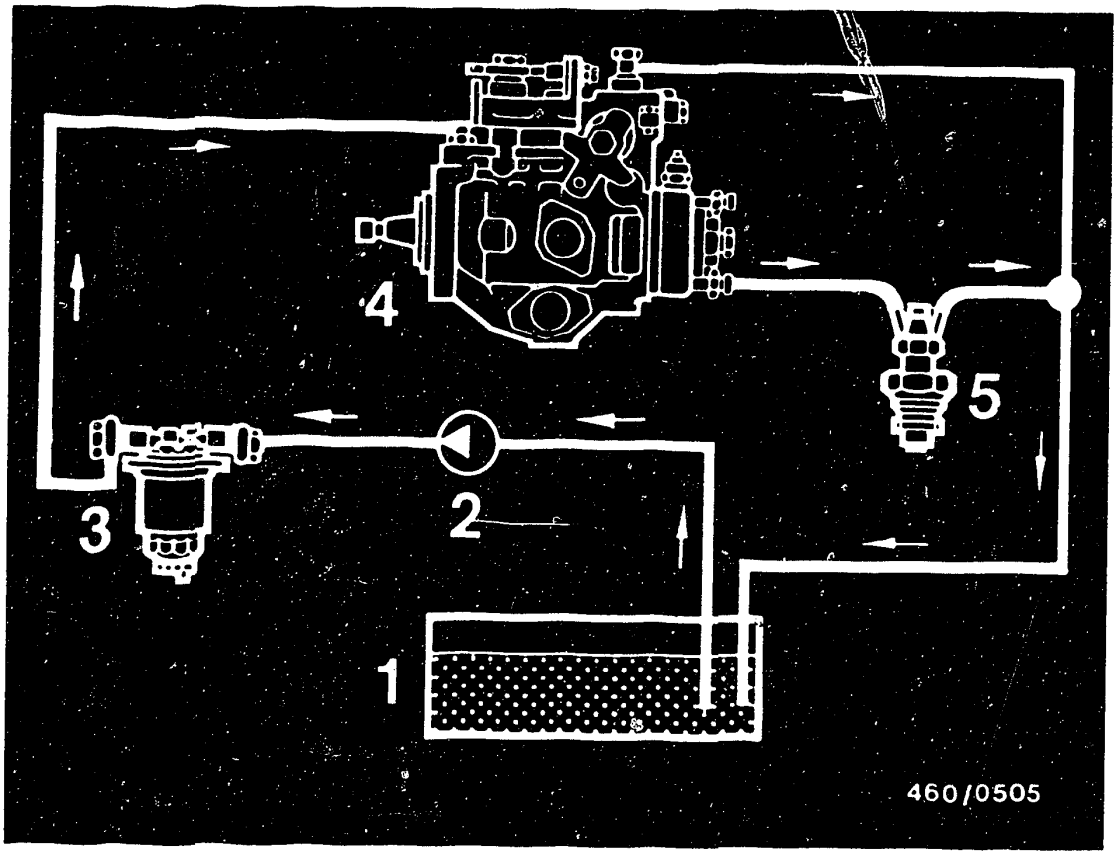
Operate emergency stop lever on injection pump (picture).



12.2.1 Solenoid-operated valve test

Remove fuel-injection tubing.
Take out solenoid-operated valve.
Cleanliness is essential.
When removed, check operation of solenoid-operated valve.

Note:
When removed, the solenoid-operated valve must only be supplied with voltage for a short period of time since it is no longer being cooled by the fuel.
Check valve seat in hydraulic head (visual inspection).

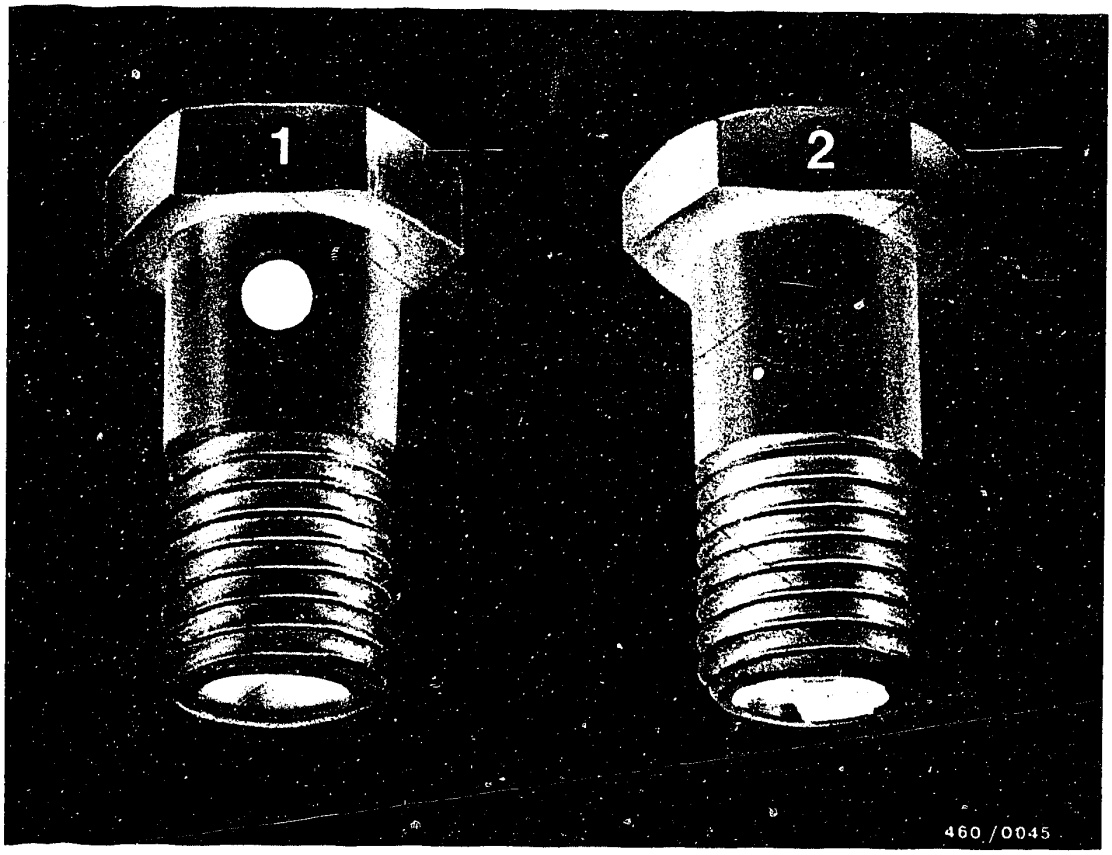


1 = Fuel tank
2 = Fuel pre-supply pump
3 = Fuel filter
4 = Distributor-type injection pump
5 = Injection nozzles

13. Diagram of fuel lines

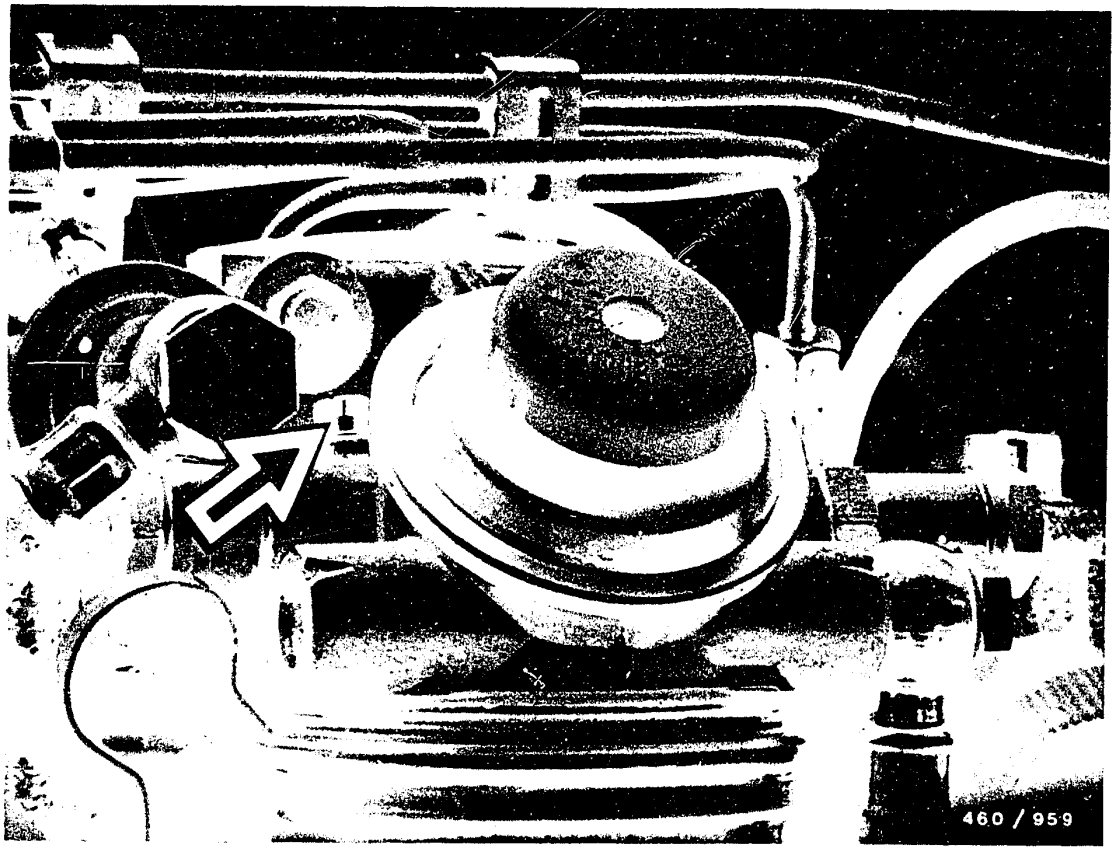
The fuel lines are connected as shown in the above diagram.

The fuel flows in the direction of the arrows.



As regards the connections to the fuel-injection pump, ensure that the inlet-union screw for fuel inlet (1) and the throttle screw for fuel return (2) are not mixed up.

The throttle screw is located on the cover of the fuel-injection pump and the head of the screw is marked with the word "out".



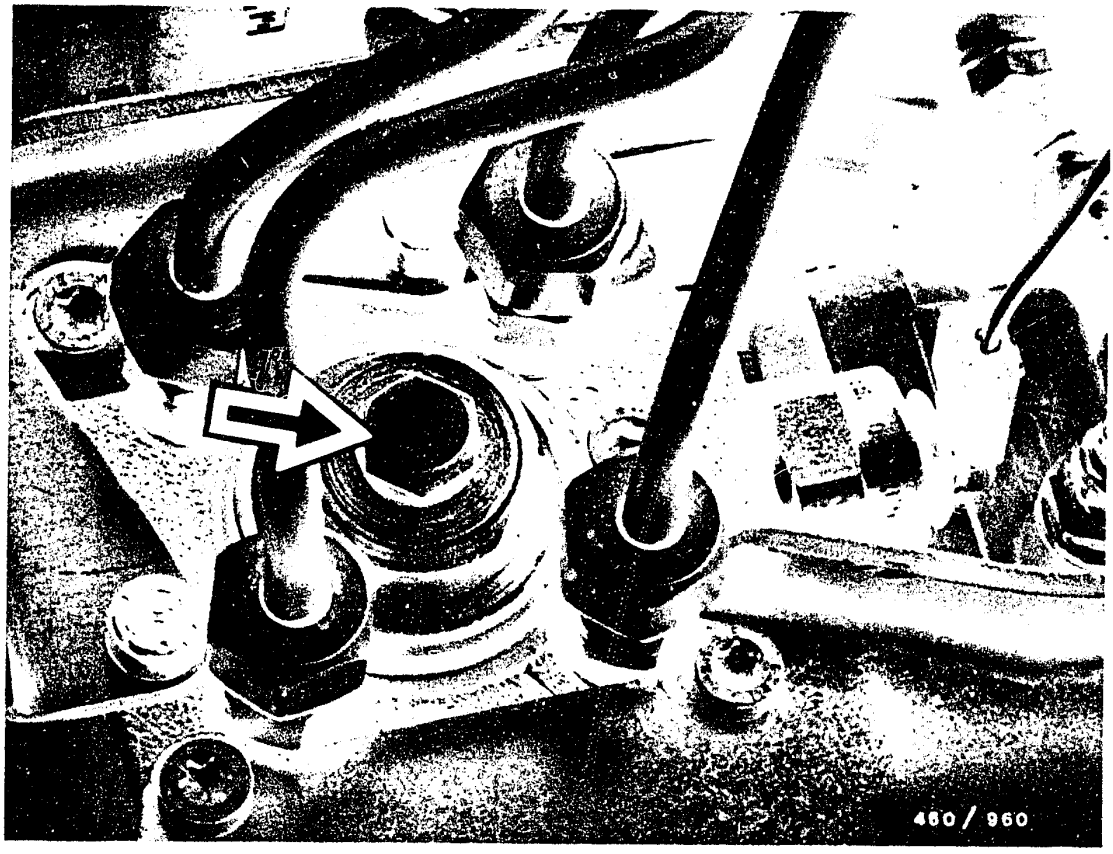
14. Bleed fuel system

Loosen bleeder screw on fuel filter (arrow).

Operate hand primer on fuel filter until fuel escaping from the bleeder screw is free of bubbles.

Tighten bleeder screw.

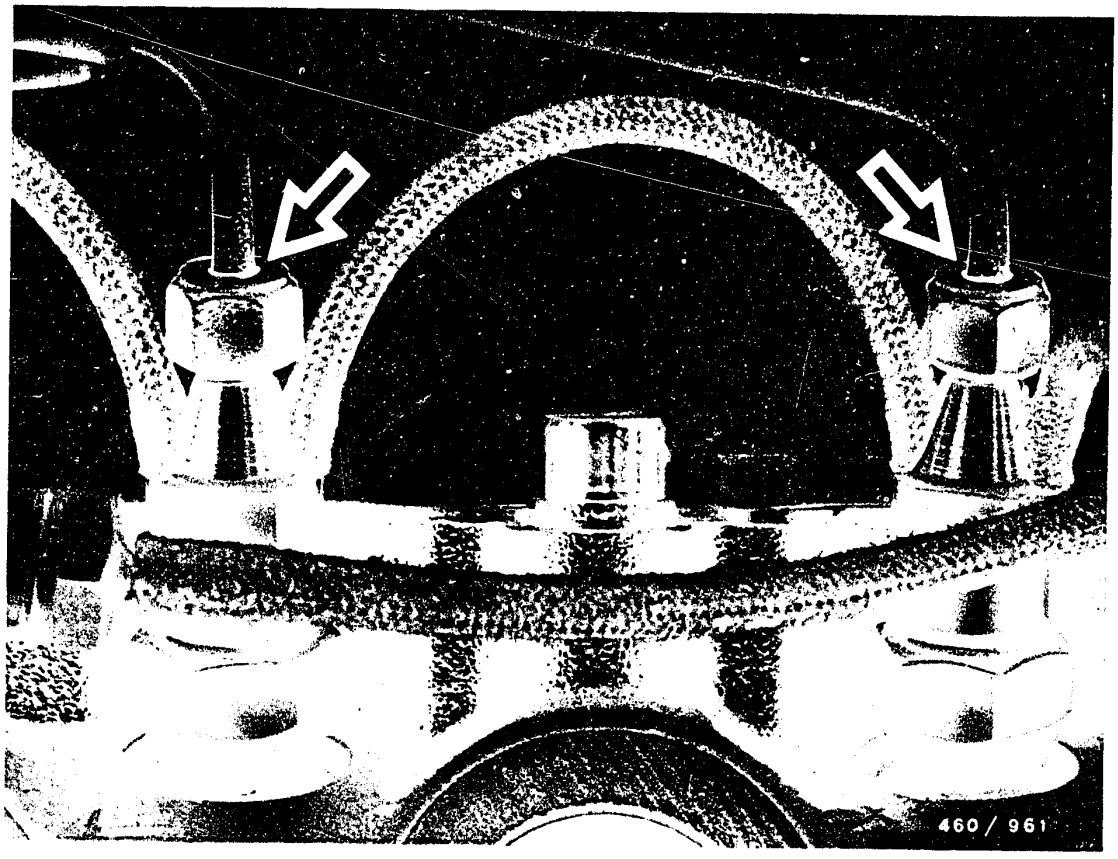
Continue to operate hand primer until resistance can be felt.



Loosen bleeder screw on injection pump (arrow) and unscrew by a few turns.

Operate hand primer on fuel filter until fuel escaping from the bleeder screw is free of bubbles.

Tighten bleeder screw.



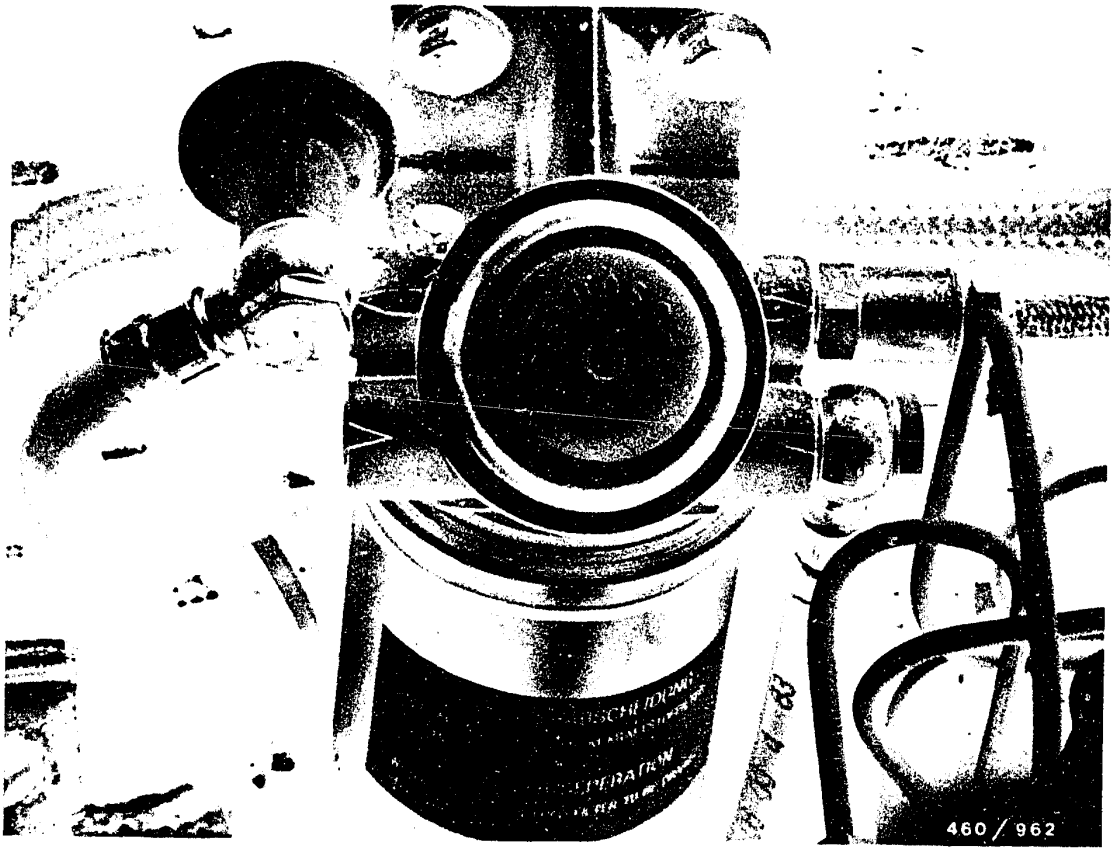
Loosen union nuts of fuel-injection tubing on nozzle-holder assemblies.

Actuate starting motor without preheating. When the fuel escaping from the bleeder hole of the injection pump is free of bubbles, tighten bleeder screw.

Continue to operate starting motor until fuel escapes from union nuts of nozzle-holder assemblies (arrows).

Tighten union nuts.

Actuate starting motor until engine starts.



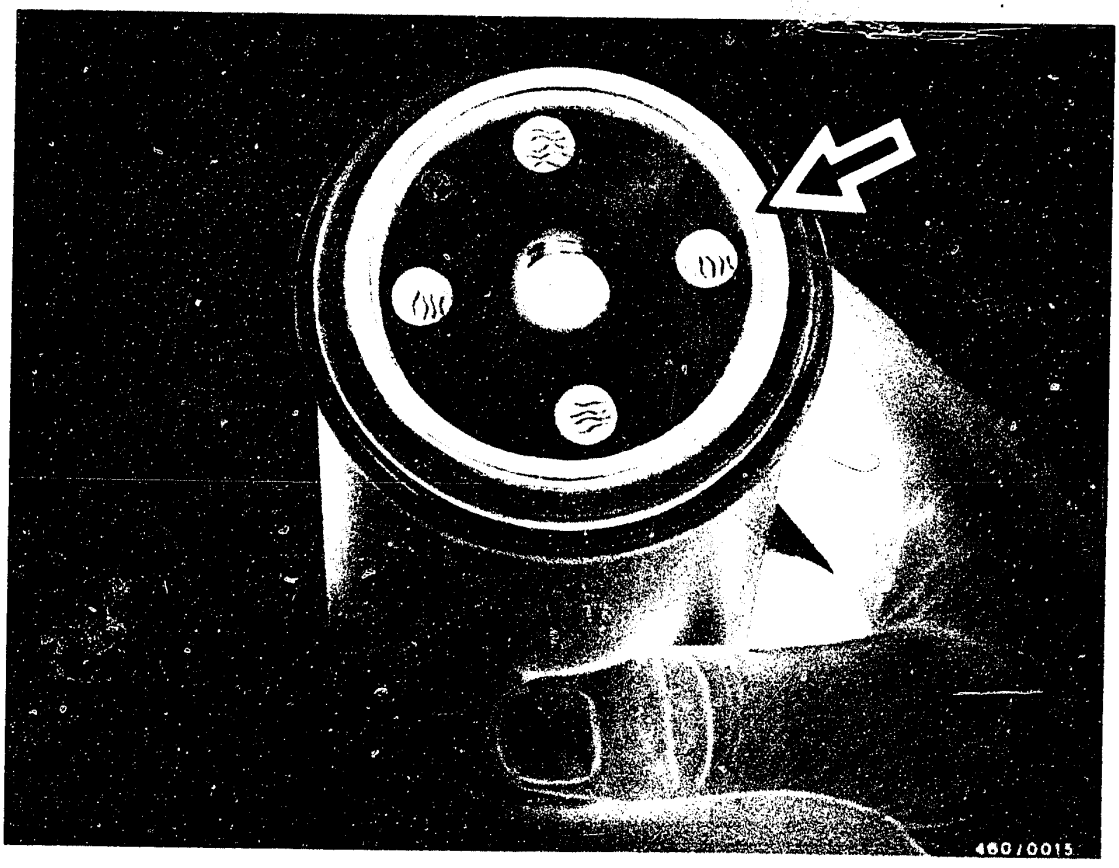
15. Replace and drain water from filter box

15.1 Replace filter box

Unscrew fuel filter from the filter cover.

If stuck, loosen filter box with special wrench, e.g. Matra W 167.

Catch escaping fuel.

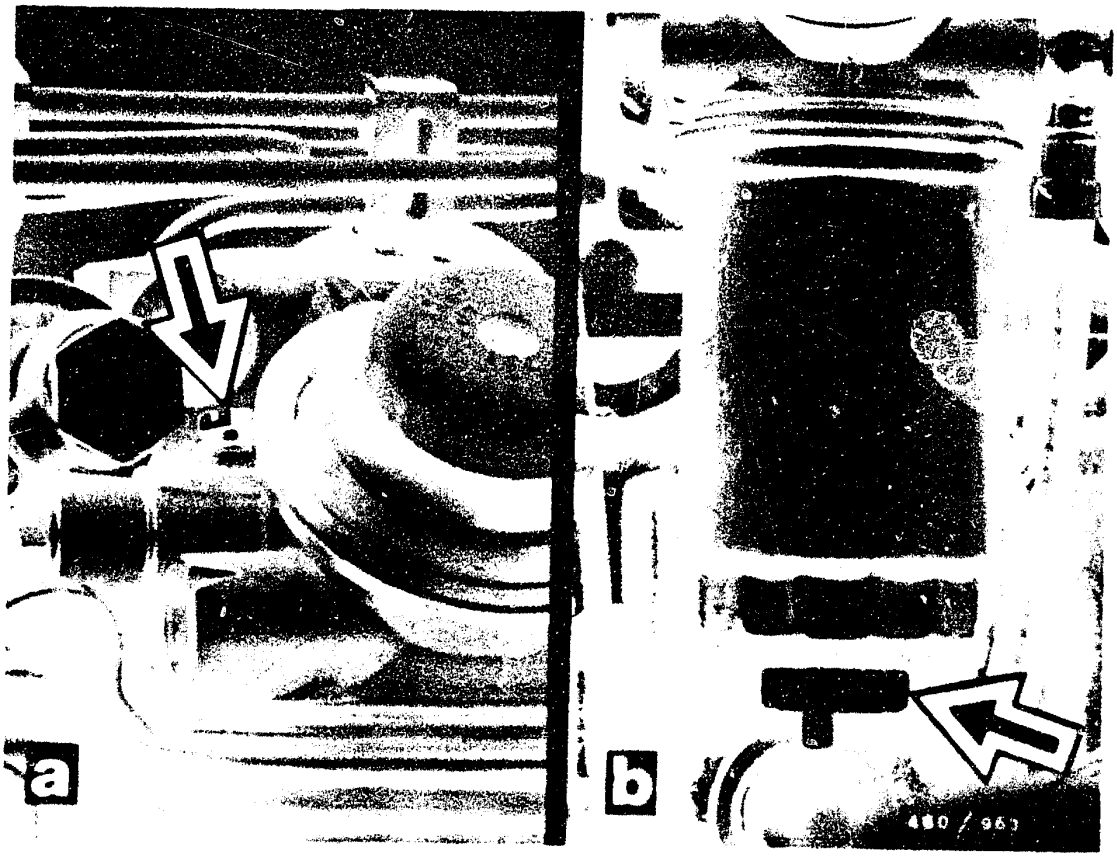


Rub diesel fuel into the rubber seal (arrow) of the new filter box.

Screw the filter box into the cover by hand and tighten.

Check the fuel filter for leaks.

In the case of winter fuel it may be necessary to add petroleum as specified by the vehicle manufacturer.

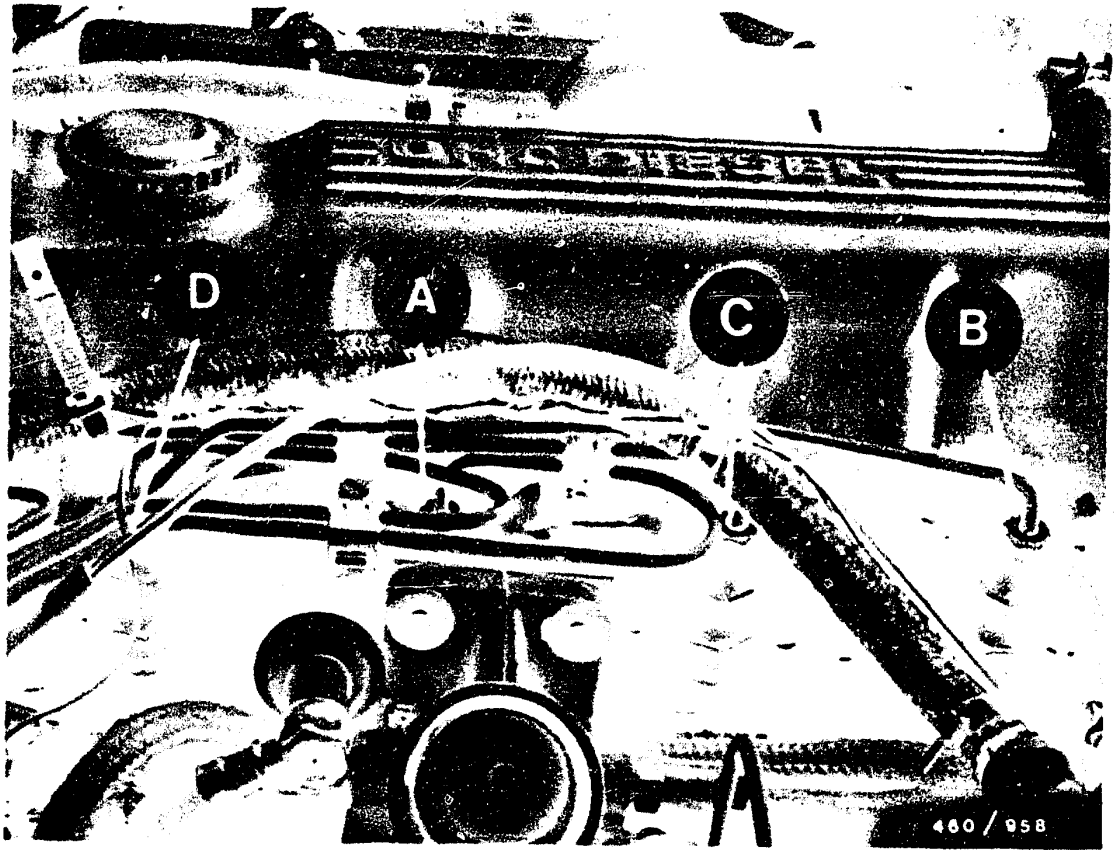


15.2 Drain water from fuel filter

Loosen bleeder screw (arrow) on the filter cover by a few turns (Fig. a).

Loosen water-drain screw on the base of the filter and drain approx. 100 cm^3 of liquid into collecting vessel (Fig. b).

Tighten water-drain screw and bleeder screw and check for leaks.

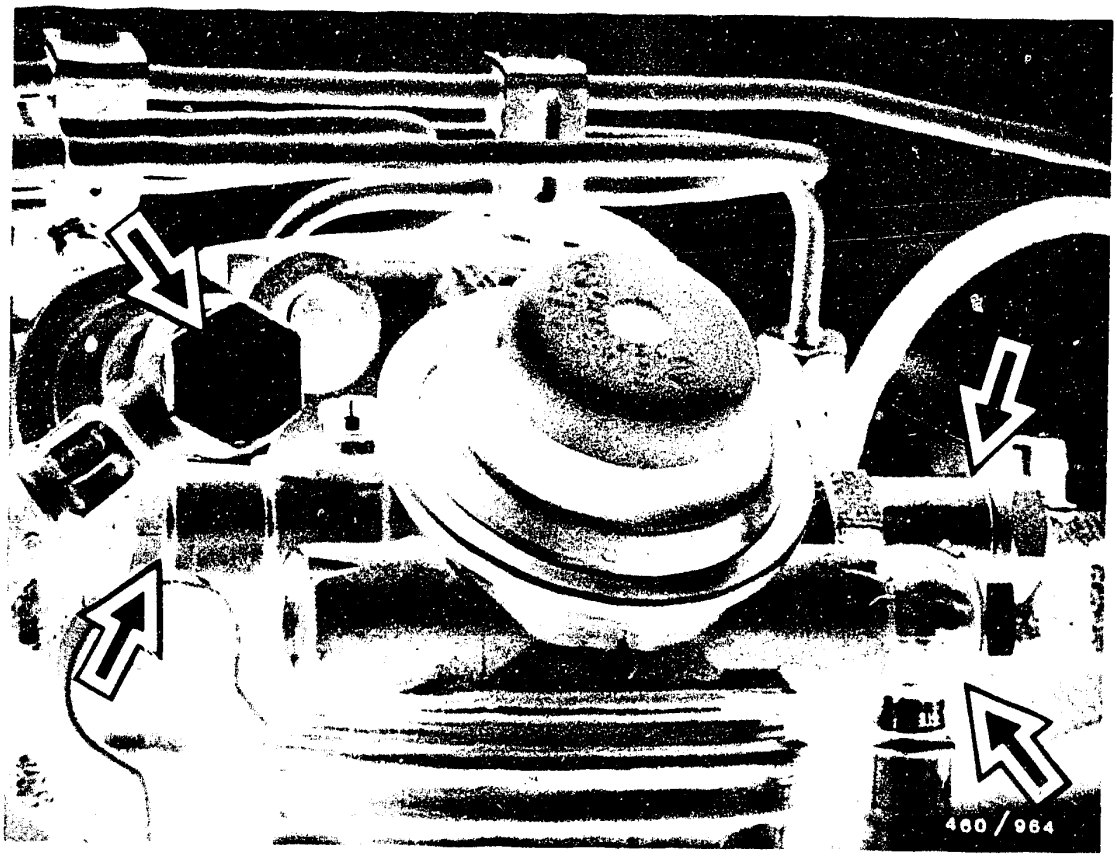


16. Check fuel-injection system for leaks

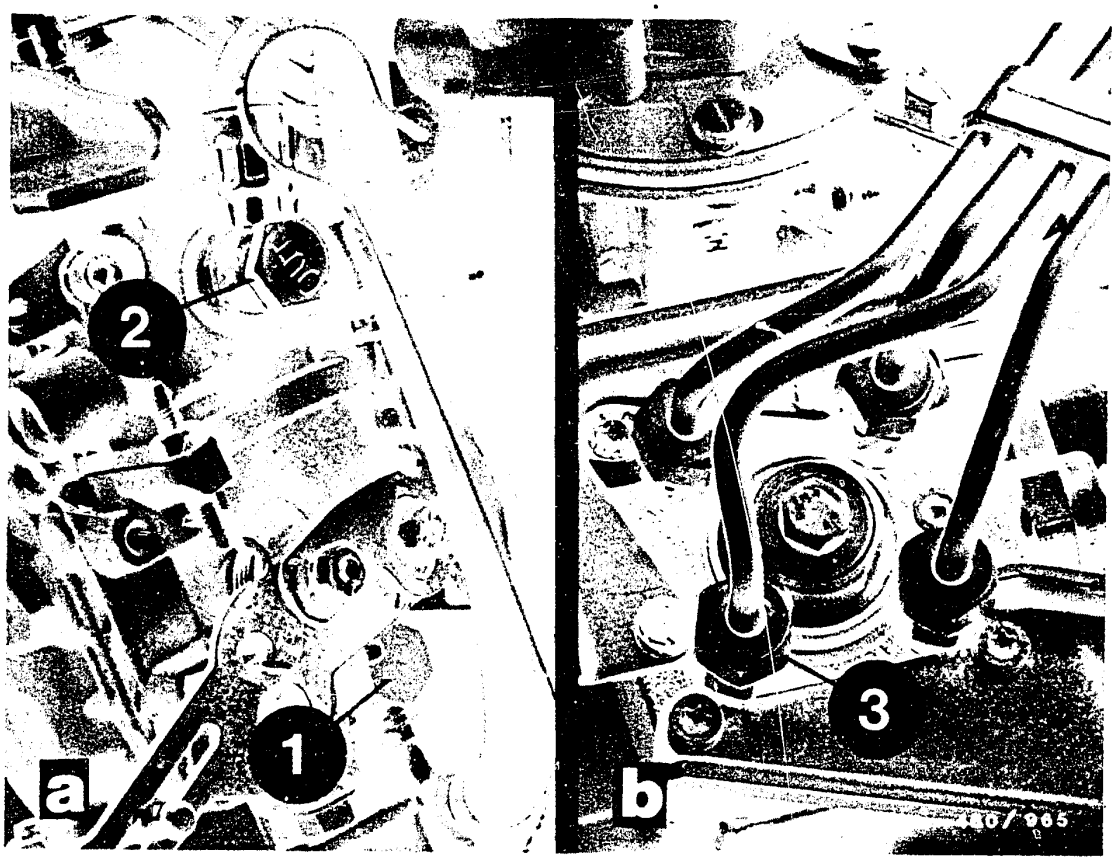
Perform leak test with engine at normal operating temperature.

Check all fuel line connecting points. Pay particular attention to:

- Connections on nozzle-holder assemblies (A...D).

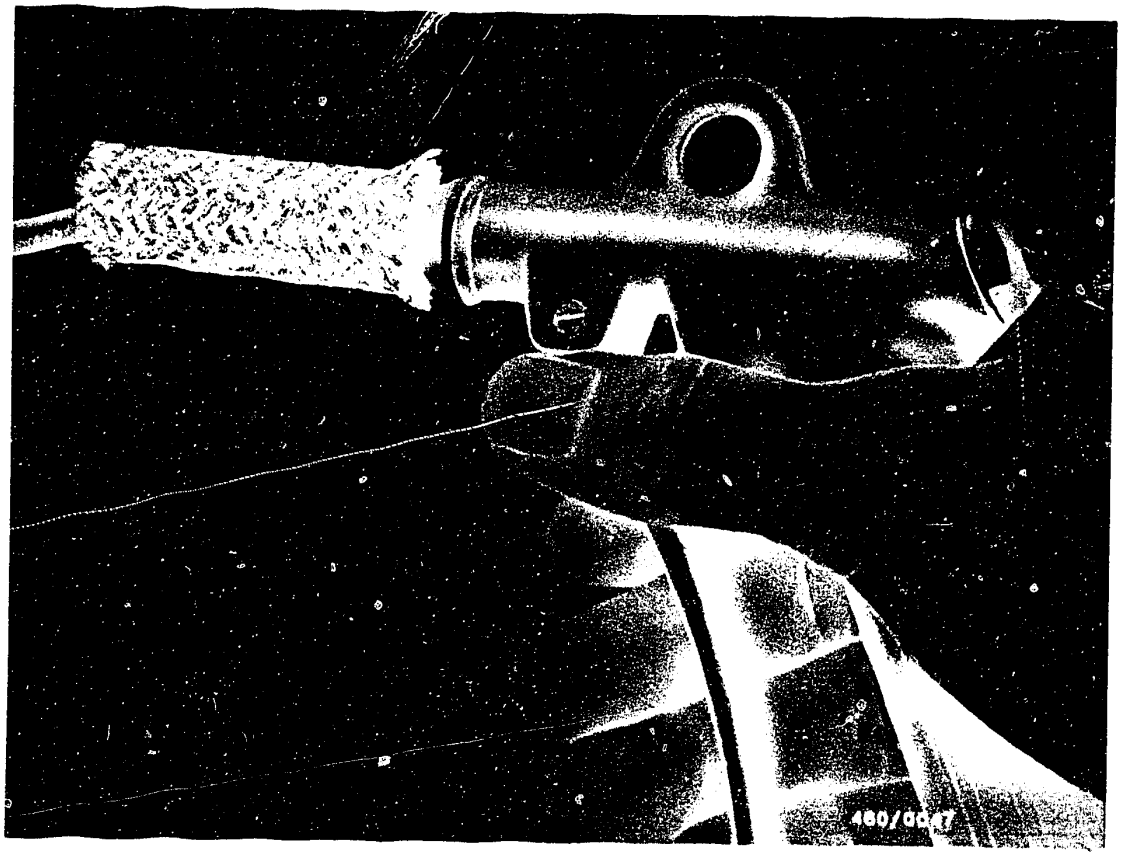


- Connections on fuel filter (arrows).



- Inlet (1) and return lines (2) on distributor-type fuel-injection pump
- Delivery-valve holders on hydraulic head (3).

Check fuel lines for hairline cracks.



17. Check fuel lines

Subject suspect fuel lines to a visual inspection.

If there is no detectable pinching or kinking, the fuel line in question must be removed.

Check fuel line for throughflow using compressed air and clean if necessary.

A suitable hose piece may be used as a side seal for blowing out the fuel lines (see picture).

18. Smoke test - check air filter

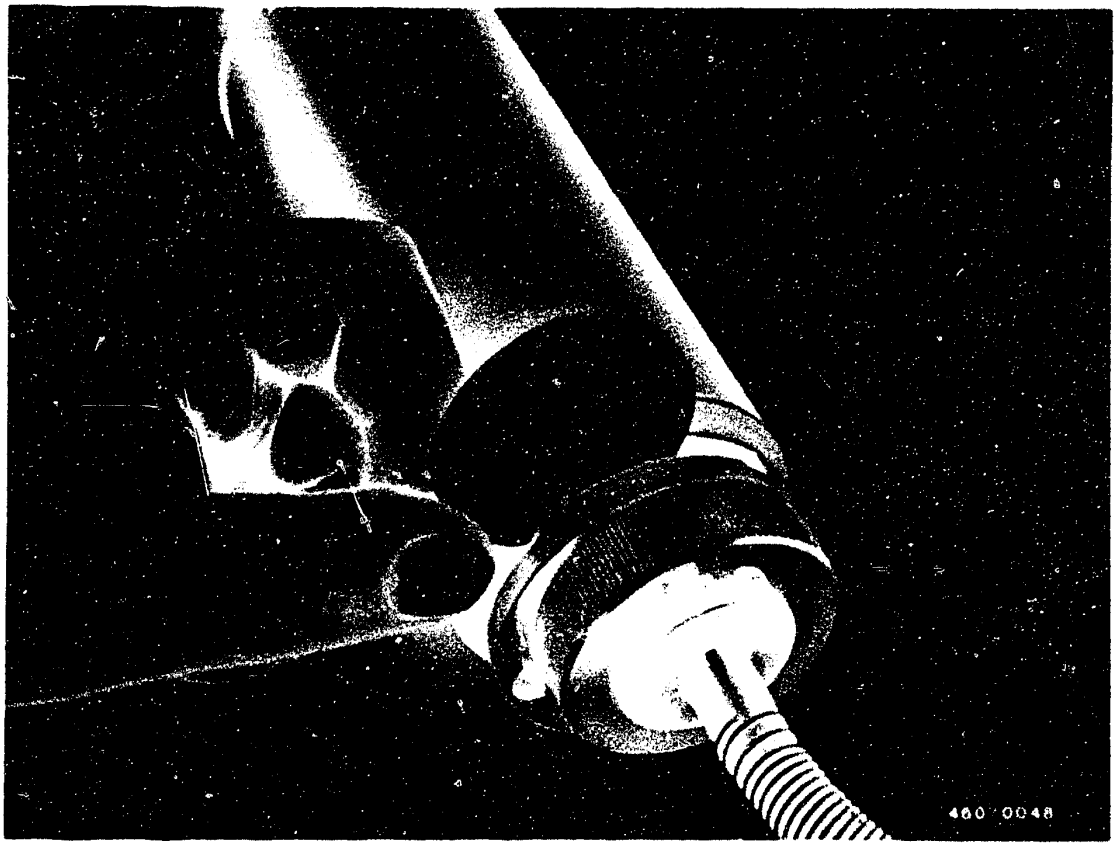
18.1 Smoke test

Summary of the contents of the legal regulations (as at April 1978). Applicable to Federal Republic of Germany.

This regulation applies only to the homologation of motor vehicles having at least 4 wheels with a maximum permissible speed of more than 25 km/h. A smoke emission test is not prescribed for official general inspections.

Parts which may have an influence on environmental pollution must be designed in such a way that the legal requirements are met during operation and despite vehicle vibration.

This applies in particular to cold-start devices and full-load stops. The Rheinland-Westfälische TOV (Technical Inspection Bureau of Rhineland-Westfalia) in Essen is the sole approval agency.

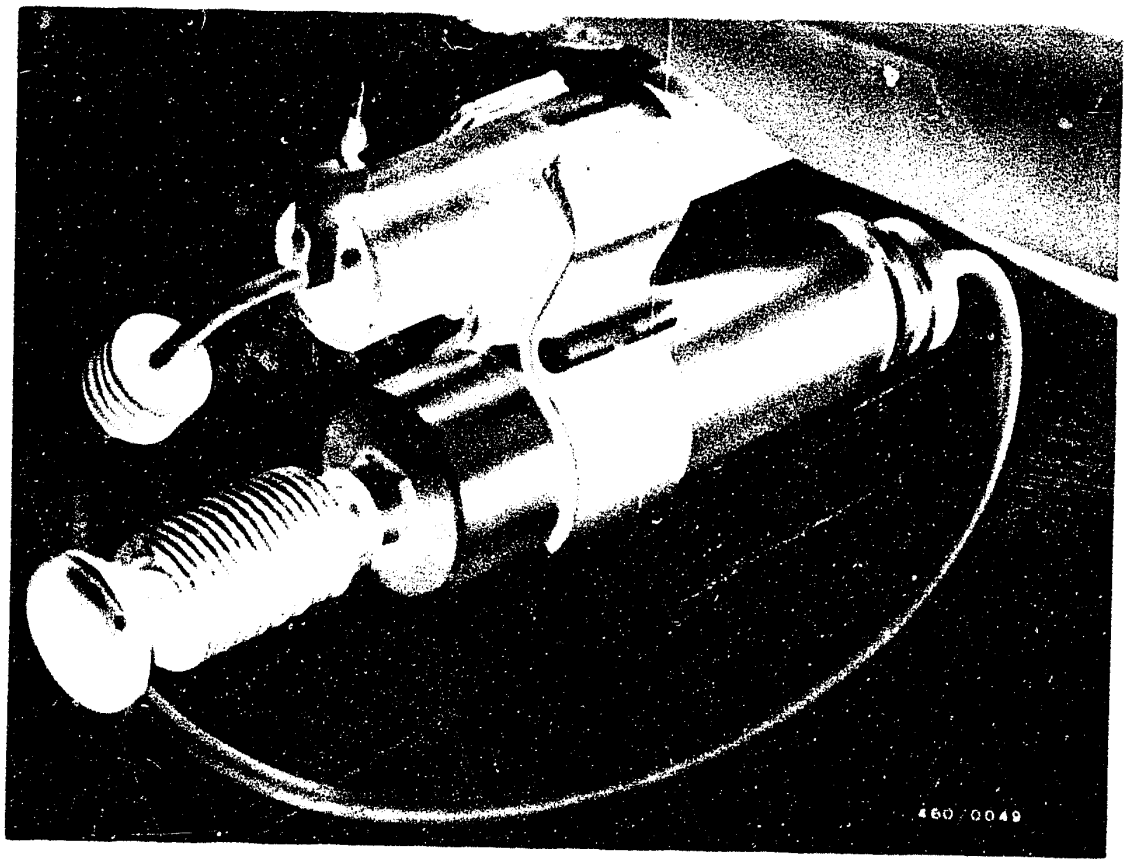


18.1.1 Test setup

The smoke test is conducted using the Bosch filter-type smokemeter.
The filter-type smokemeter consists of the following units:

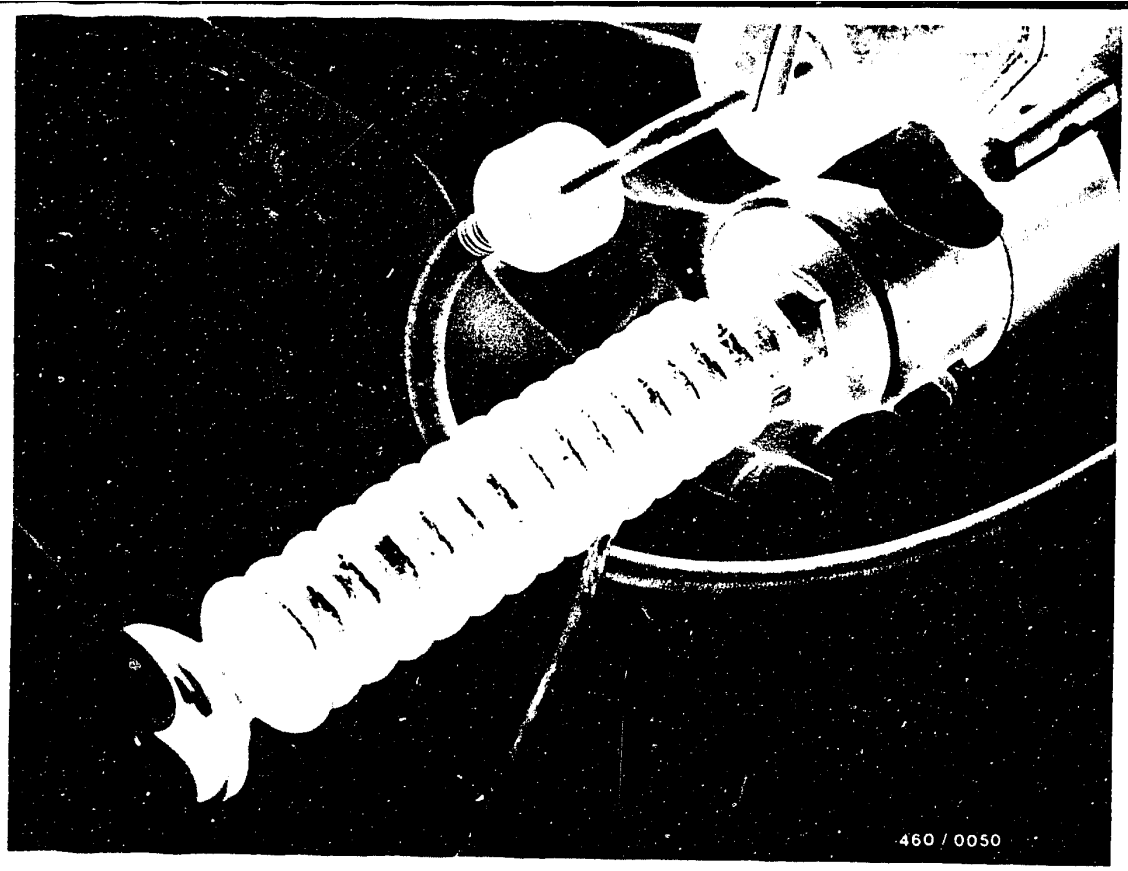
- Accessories box with proportioning pump — 0 681 169 038
- Evaluating unit — 0 684 102 050

Insert filter plate into proportioning pump.



Mount sampling pump on exhaust pipe using appropriate clamp.

Introduce exhaust-sample pickup as far as possible into exhaust pipe and clamp in position.

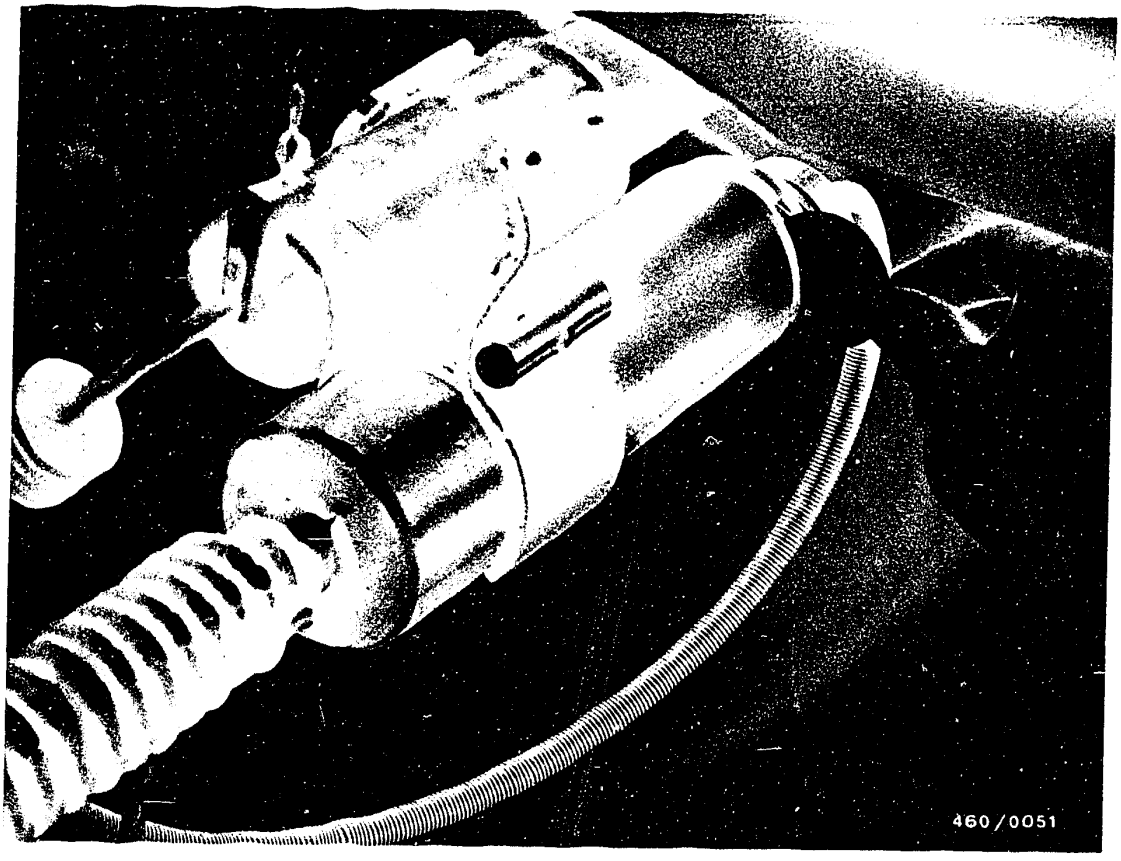


18.1.2 Test procedure

Set proportioning pump by pressing in the black push-button.
Take rubber ball on triggering hose and enter passenger compartment.

The test can be performed on the chassis dynamometer or on the road (gradient).

The chassis dynamometer is preferable in any case. Find the gear in which, with the accelerator pedal in the full-load position, a speed of approx. 40 km/h is reached. Load the engine so that, with the accelerator in the same position, a speed of approx. 25 km/h is reached.

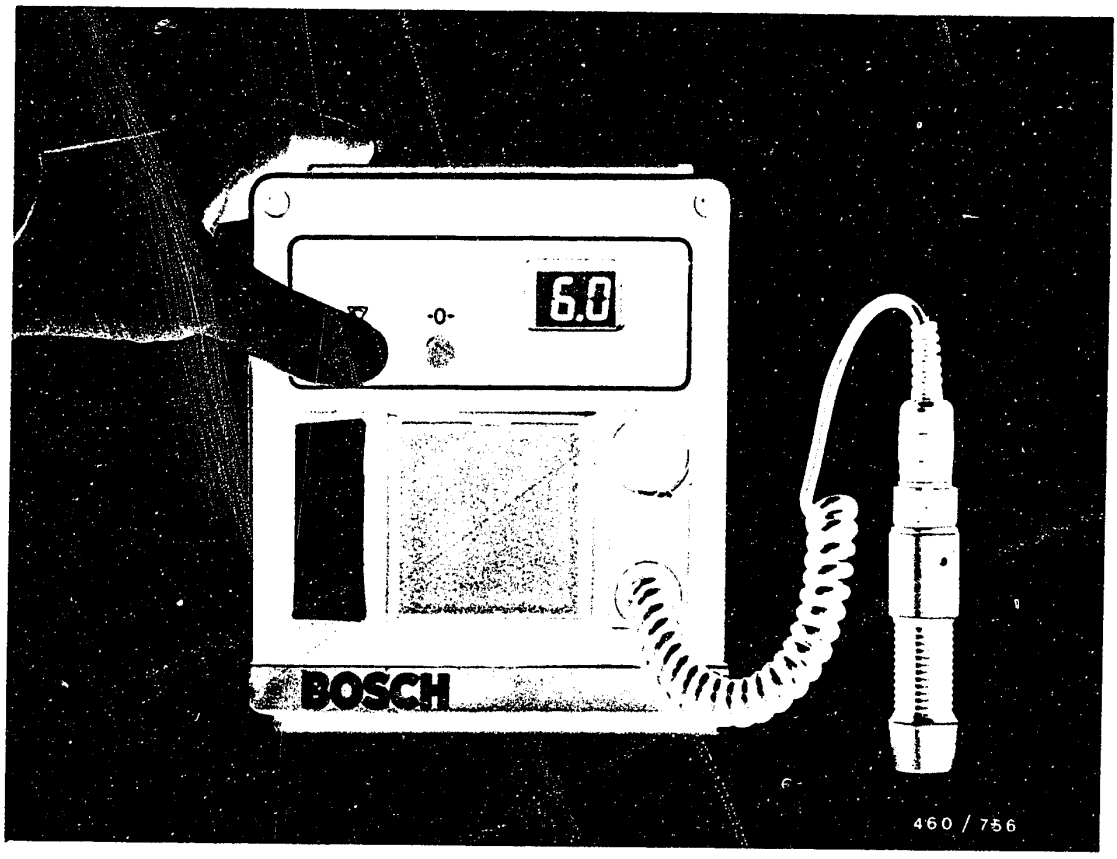


Maintain this load condition for 5 seconds and then trigger the sampling pump by pressing the rubber ball.

Switch-off engine.

Caution!
During the following operation, pay attention to the fact that the exhaust pipe has been heated due to the running of the engine.

Remove filter plate from sampling pump.



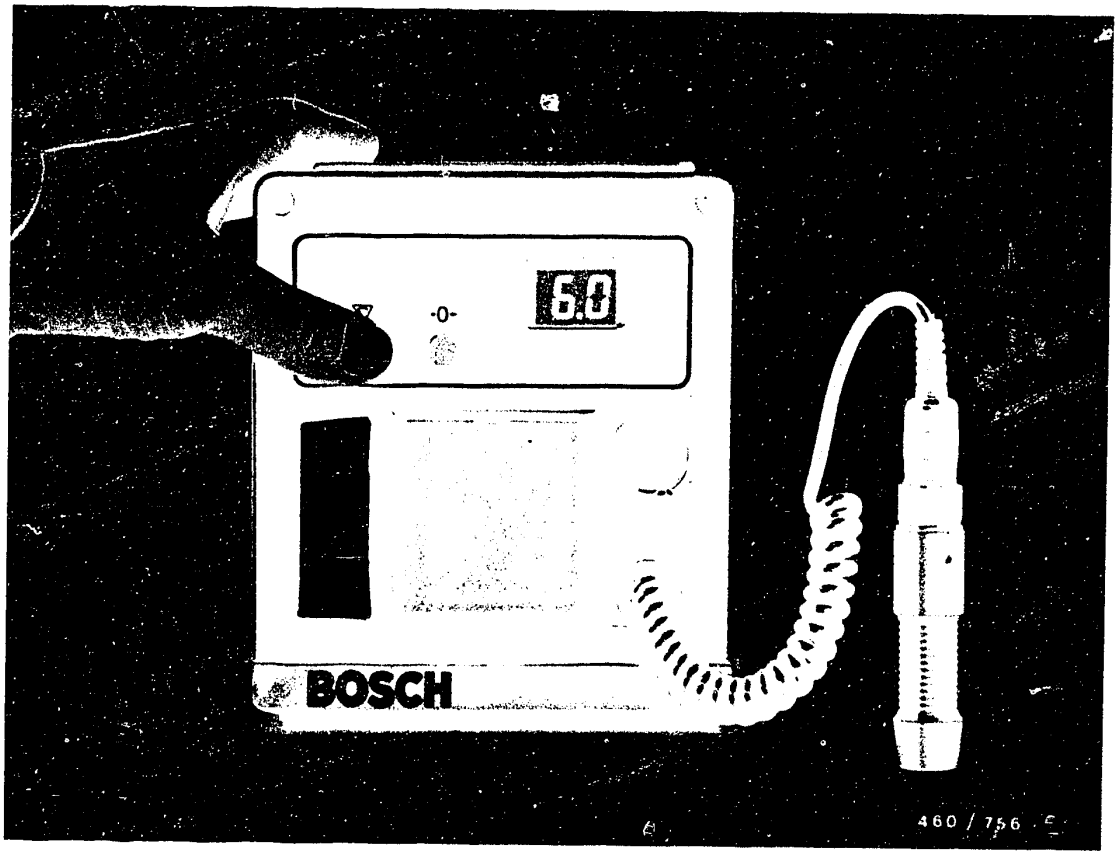
Setting the Zero Point

The zero point adjustment must be performed

- before each measurement series
- if there are changes in ambient conditions
- each time the lens of the photo-element adapter has been cleaned.

Firmly press the measuring head of the photo-element adapter onto 5 clean, white filter plates placed one on top of the other.

Press button "0" until display 0.0 appears.
Release button "0".



Measuring

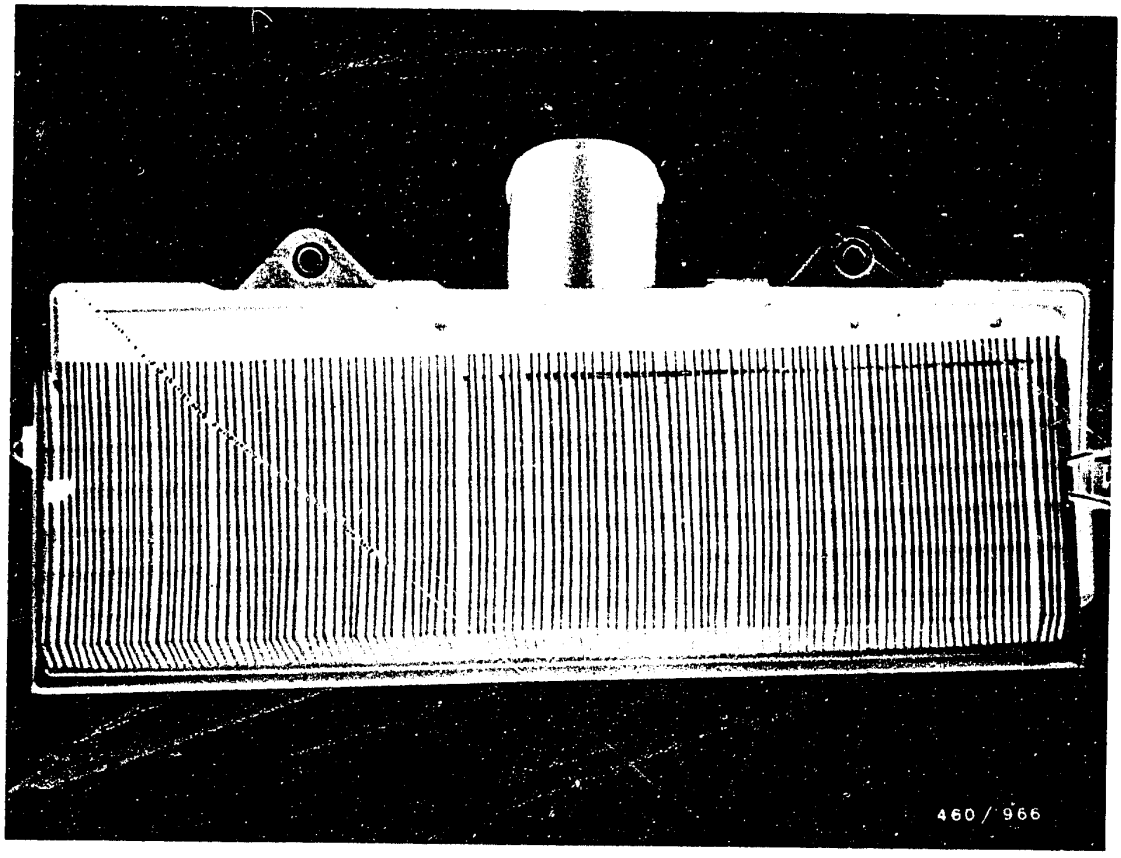
With the sooted side at the top, lay filter plate from metering unit on 3 new filter plates placed one on top of the other.

Press measuring head vertically on to black surface of filter plate. At the same time, press button "C" until smoke number appears in display.

Note:

Measuring head must be firmly mounted both for the zero point adjustment and for measuring (even slight tilting may lead to incorrect measurements).

Compare the smoke number with the evaluation sheet. Note kW (HP) information of vehicle manufacturer.



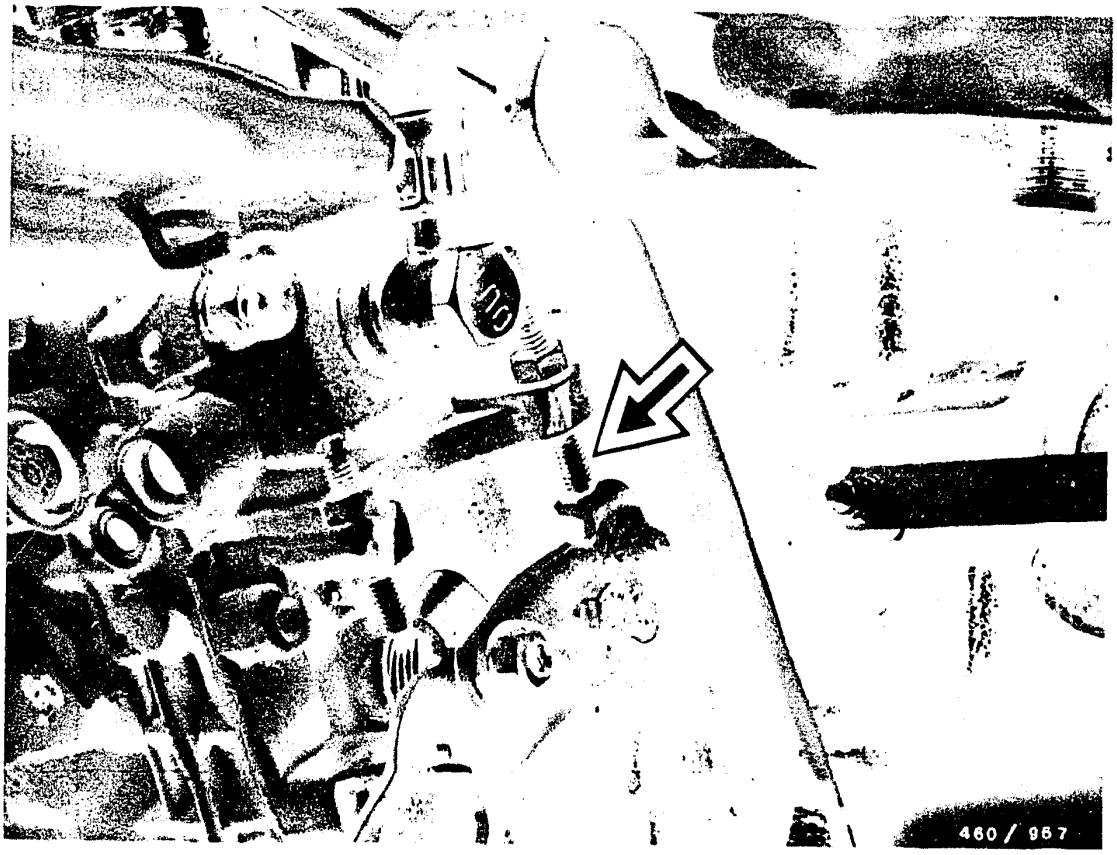
18.2 Check air filter

Remove air filter and subject to a visual examination.

Test criteria for air filter:

- Dusty air filter (test by knocking out air filter)
- Oil-fouled air filter
- Solid matter in air filter, e.g. leaves

If in doubt, use a new filter element.



19. Adjust idle speed

Connect tachometer (e.g. photoelectric) to engine. Start engine and run at idle speed.

Note:

In order to adjust the idle speed the engine must be at normal operating temperature, coolant temperature 80°C.

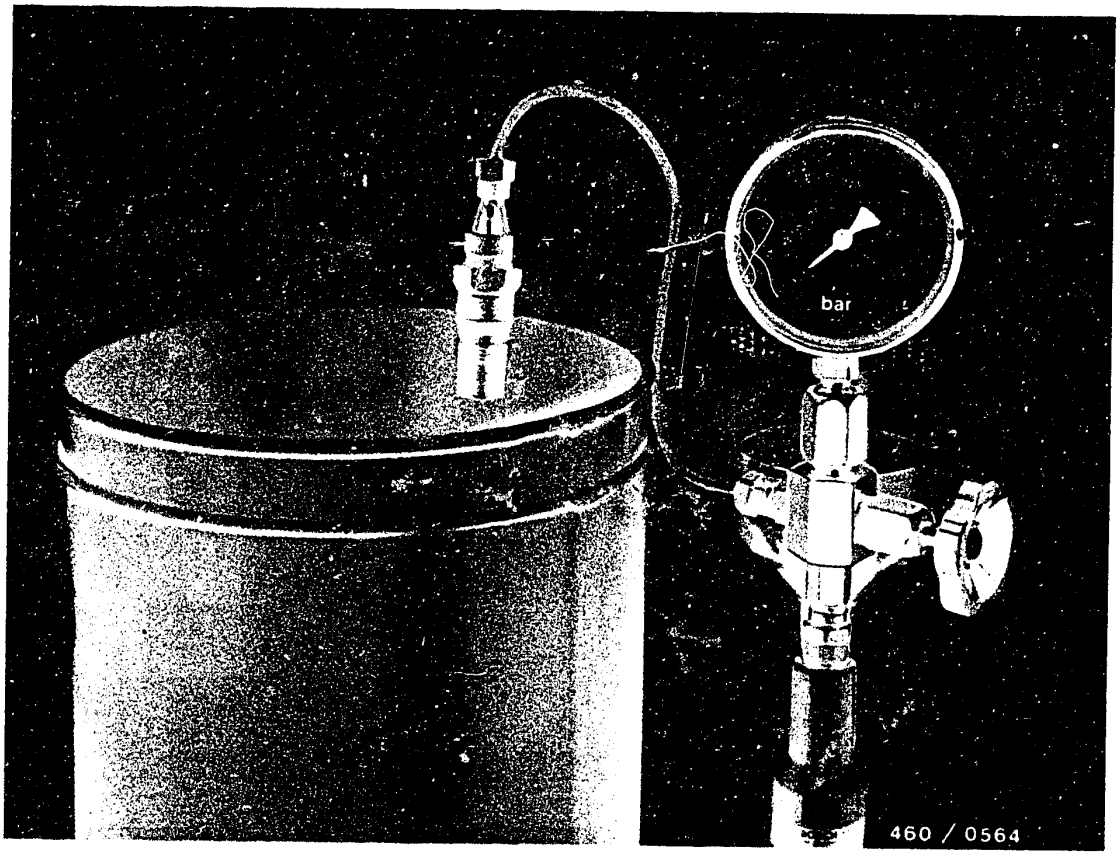
Adjust engine speed at idle adjusting screw (arrow):

Vehicles to 8.83: 650 ... 750 min^{-1}

Vehicles as of 9.83: 700 ... 750 min^{-1}

Note that the camshaft and the injection pump are driven at half the engine speed.

After adjusting, lock and seal the adjusting screw.



20. Test injection nozzles

Remove injection nozzles.

The test is performed using the nozzle tester EFEP 60 H 0 681 200 502.

Mount injection nozzle with nozzle-holder assembly on nozzle tester.

In order to ensure that the nozzle is not distorted, operate hand lever of nozzle tester vigorously a few times with the pressure gauge switched off (approx 4 to 6 downward movements/second).

Notes:

When testing injection nozzles, make sure that the fuel spray does not strike your hands since, due to the high pressure, the fuel will penetrate into your skin and may cause blood poisoning.

For testing use clean calibrating oil to ISO 4113 or clean diesel fuel.

Test criteria:

- Opening pressure
- Leaks
- Chatter behaviour
- Spray pattern

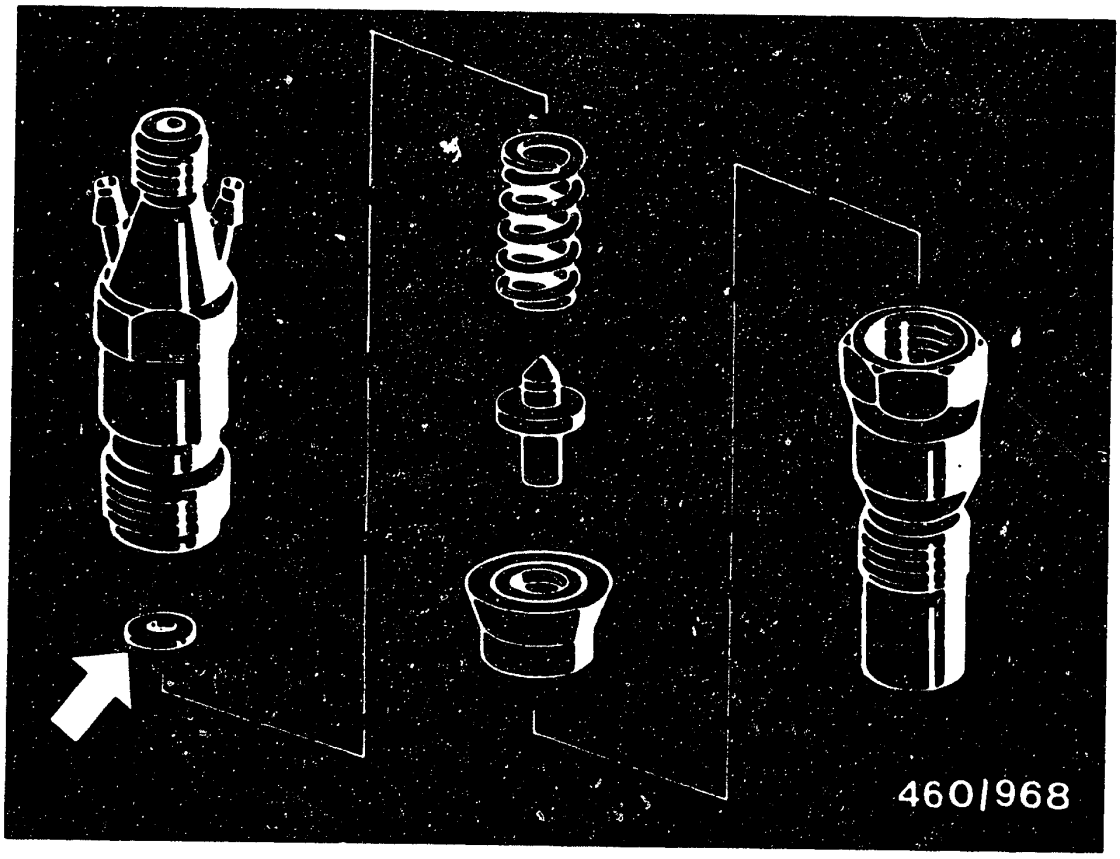
20.1 Test opening pressure

Open squirt valve on pressure gauge approx 1/4 turn.

Slowly depress hand lever of nozzle tester (pressure rise on pressure gauge).

Observe at what pressure the pointer of the pressure gauge steadies (nozzle not chattering) or the pressure suddenly drops (nozzle chattering).

The thus obtained maximum pressure is the opening pressure.



In the case of deviations from the nominal value, correct the nozzle-opening pressure by means of shims behind the pressure spring (arrow).

Nominal value: 2.0 D; 2.1 D; 2.3 D up to 8.83 120 + 5 bar
2.3 D; 2.3 TD as of 9.83 135 + 8 bar

thicker shims = higher nozzle opening pressure
thinner shims = lower nozzle opening pressure
+/-0.05 mm change in spring travel causes a change in the nozzle opening pressure of approx 5.0 bar.

20.2 Leak test

Open shutoff valve on pressure gauge approx 1/4 turn.

Dry off lower part of nozzle and of nozzle-holder assembly (blow dry with air).

Slowly depress hand lever until pressure gauge indicates 20 bar below the previous opening pressure reading. The nozzle is leak-tight if no drop falls from the mouth of the nozzle within 10 seconds.

If a drop falls, dismantle nozzle-and-holder assembly and clean.

If still leaking, replace nozzle.
Reworking parts of the nozzle is not allowed.

Note:
Scoring on the supporting device and intermediate disc may be reworked if applying the appropriate care (except during the warranty period).

20.3 Chatter test, Evaluation of spray pattern

General:
When evaluating the nozzles, a distinction must be made between new and used nozzles.

Switch off pressure gauge.

New nozzles:

The chatter test permits an audible check of the freedom of movement of the nozzle needle in the nozzle body. If, despite cleaning, the nozzle does not chatter, it must be replaced by a new nozzle. The shape of the spray is of no significance for the chatter test. A regulation spray pattern is generally only present on new nozzles.

Used nozzles:

The chatter behaviour of the nozzle deteriorates due to wear in the seat area. When the lever is operated quickly, the nozzle must chatter and/or must squirt a well atomized spray.
In the case of used nozzles, the spray pattern may deviate from the ideal shape of a new nozzle.
However, the spray pattern of such nozzles can be noticeably improved by appropriate cleaning.

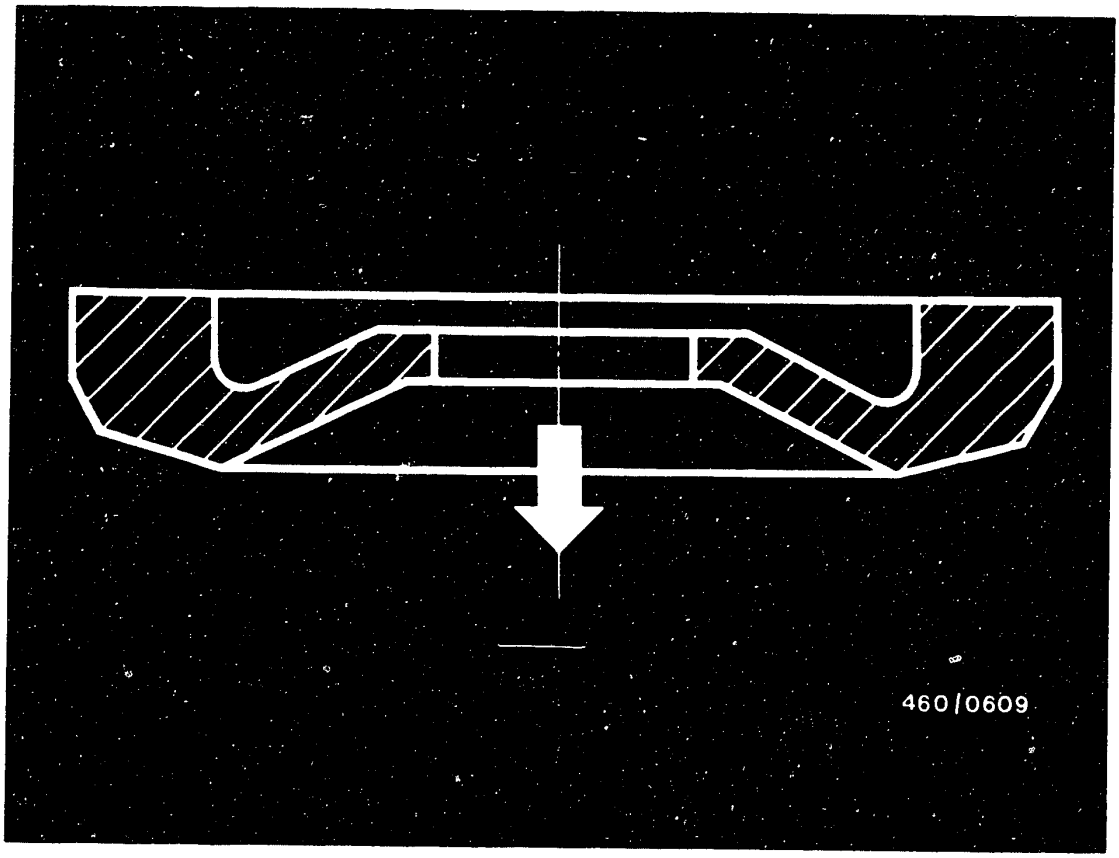
20.4 Chatter and spray test (nozzle-type related)

This concerns pintle nozzles with throttling action which are installed in all engine types.

These nozzles have a special base form and an additional spray hole through which the prespray escapes.

Chatter test:
Due to its special structural features this nozzle chatters very softly. A chatter test is possible with this nozzle only between 1...2 downward movements of the hand lever per second. As the test speed is raised the chattering stops. The calibrating oil then escapes with a hissing noise from the nozzle. The nozzle chatters with a high whistling tone only with rapid movement of the hand lever (about 4...6 downward movements per second).

Spray pattern: (applies only to new nozzles)
At low test speed the major portion of the delivered fuel must escape through the lateral prespray hole, well atomized. An evaluation of the main spray is only possible when the hand lever is moved rapidly (approx 4...6 downward movements per second). The spray must be concentrated and well atomized.



20.5 Install injection nozzles

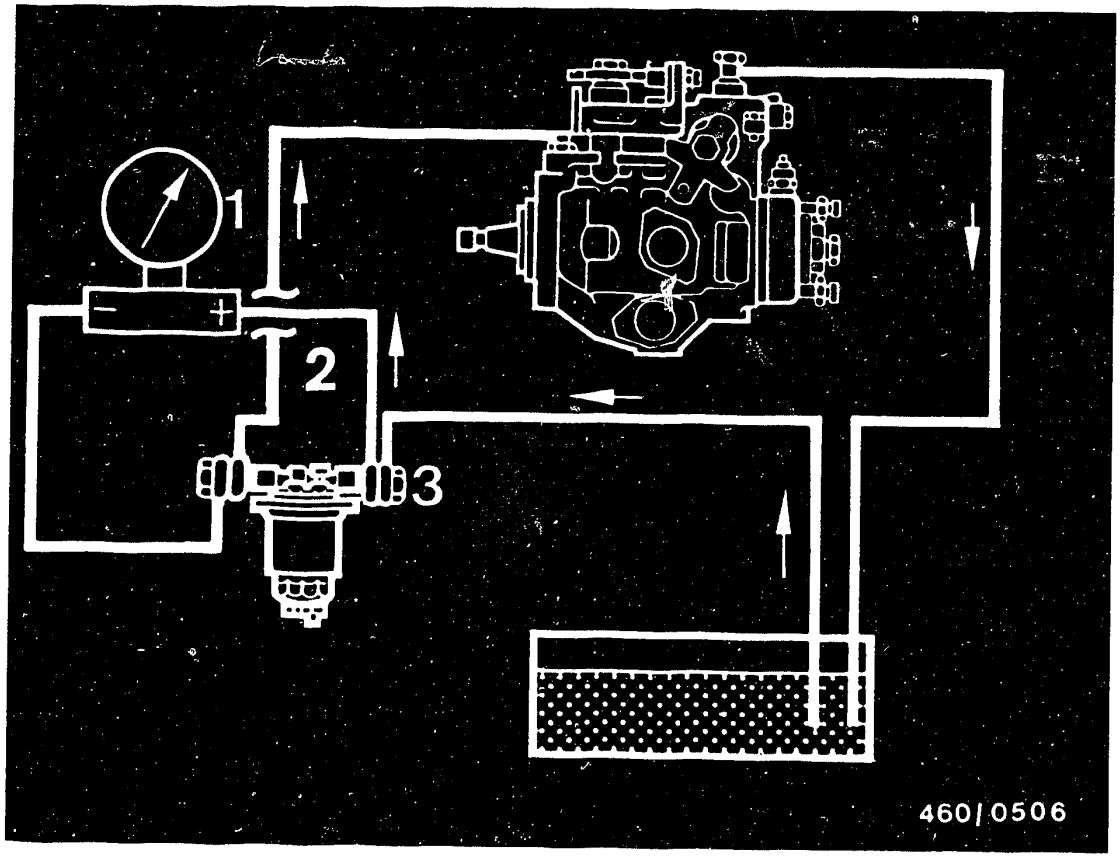
Before installing the injection nozzles, insert a new heat-protection disc the right way round in the cylinder head. This is both for shielding as well as for tolerance compensation (sealing cone 150° in direction of arrow).

Then screw nozzle-holder assembly into cylinder head and tighten to 70 Nm.

Note:

If the tightening torque is exceeded, the nozzle needle may stick.

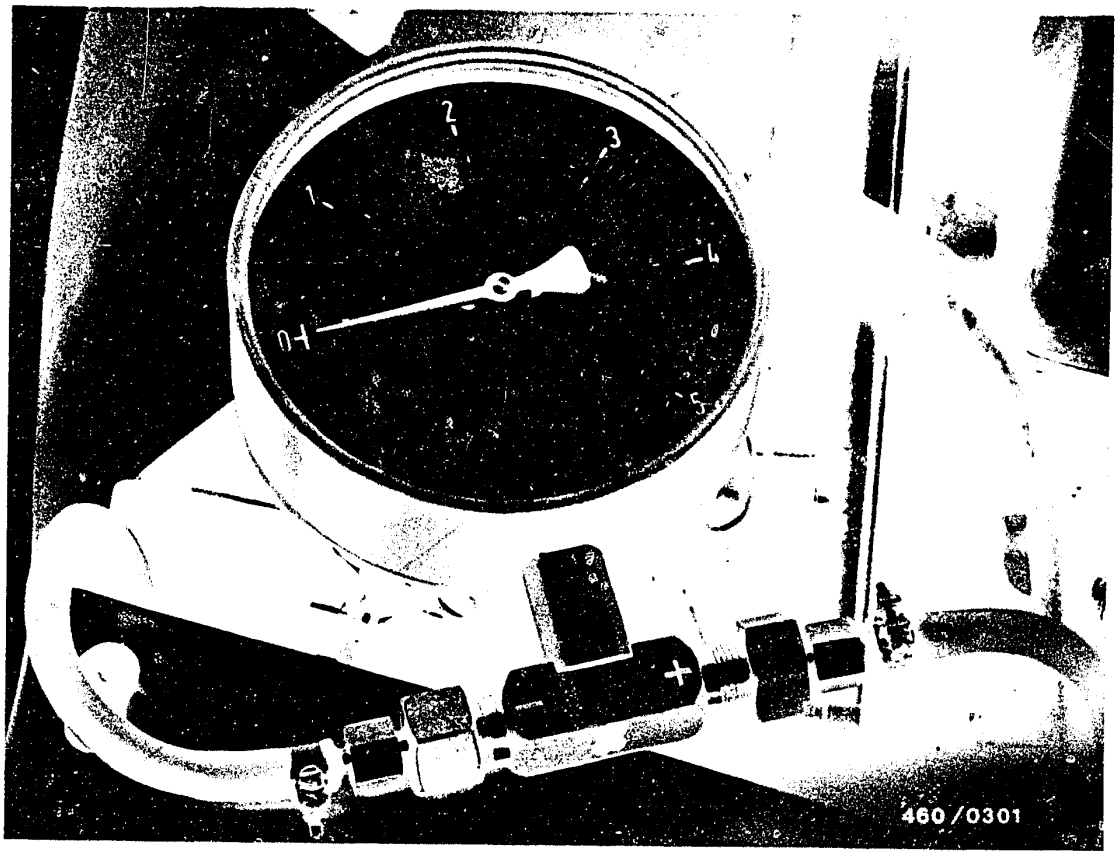
Tighten union nuts of fuel-injection tubing to 20 Nm.



1 = Differential-pressure gauge
2 = Filter outlet (use inlet union and extra-long inlet-union screw 2 443 456 020).
3 = Filter inlet (use inlet union and extra-long inlet-union screw 2 443 456 020).

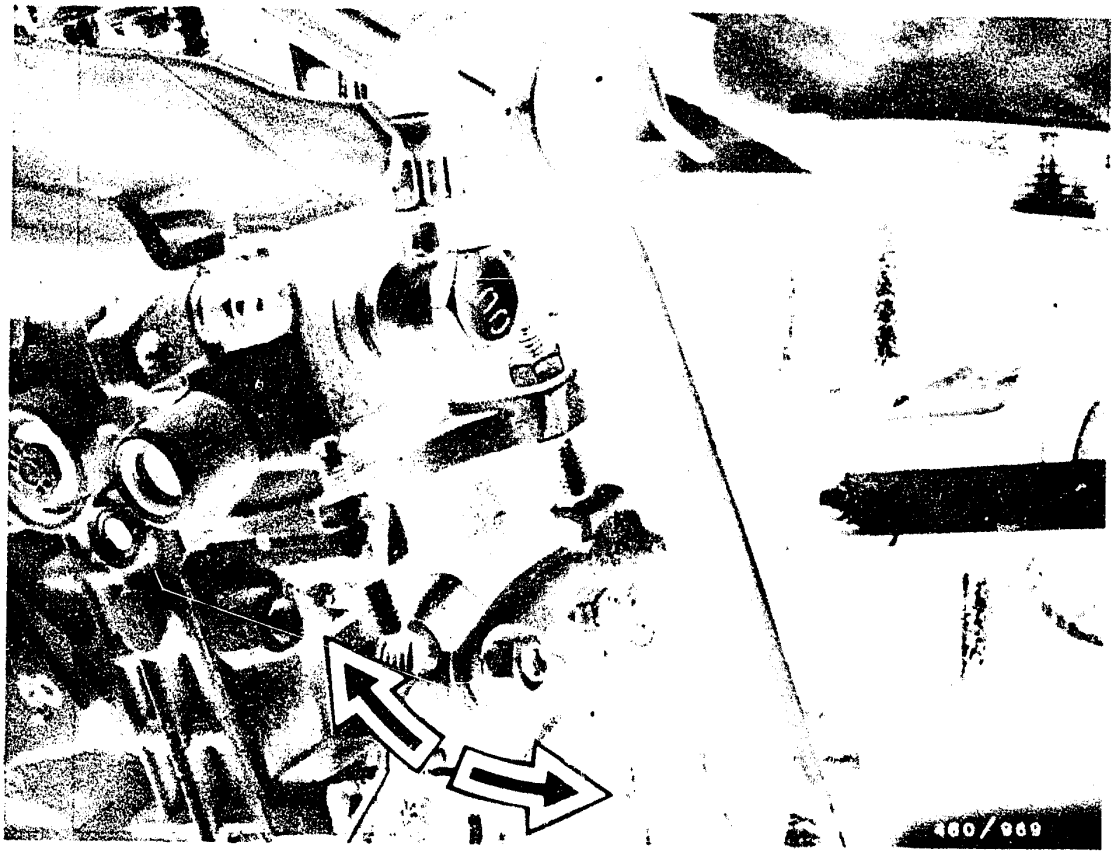
21. Connection diagram for filter test (differential-pressure test)

Connect differential-pressure gauge to fuel filter using appropriate connecting pieces.



Connect the (+) side of the differential-pressure gauge to the fuel filter inlet. Fit the (-) connection of the pressure gauge to the filter outlet. See connection diagram.

Run engine until you are sure that there is no air in the fuel system.



Move injection-pump control lever briskly (approx 1 second) from the idle stop to the maximum-speed stop.

Release control lever and read off differential pressure on pressure gauge.

The differential pressure may be max. 0.3 bar.
If this value is exceeded, replace filter. Remove test connections.

If necessary, bleed fuel system.

22. Check pre-heating system

22.1 Necessary test equipment

Voltmeter/ammeter e.g. ETT 011.00 0 684 101 100

22.2 Workshop information

22.2.1 We recommend that the "R"-type sheathed-element glow plugs be replaced every 45 000 km.

22.2.2 Pre-heating times

The pre-heating time is dependent on the ambient temperature.

Test conditions

Battery fully charged.

Compresssion OK, if necessary, check compression loss.

Fuel supply/fuel-injection system OK.

Note:
If the starting motor is not operated after the repeater lamp goes out, the preheating system switches off automatically after 25...30 sec.

Starting motor operates, engine fails to start or starts only with great difficulty

All engines are equipped with a rapid-starting preheating system.

Check glow-plug warning lamp.

Turn glow-plug and starter switch to preheating.

Glow-plug warning lamp must light up.

Glow-plug warning lamp lit?

Note:
After 25 ... 30 sec the system switches off automatically.

no →

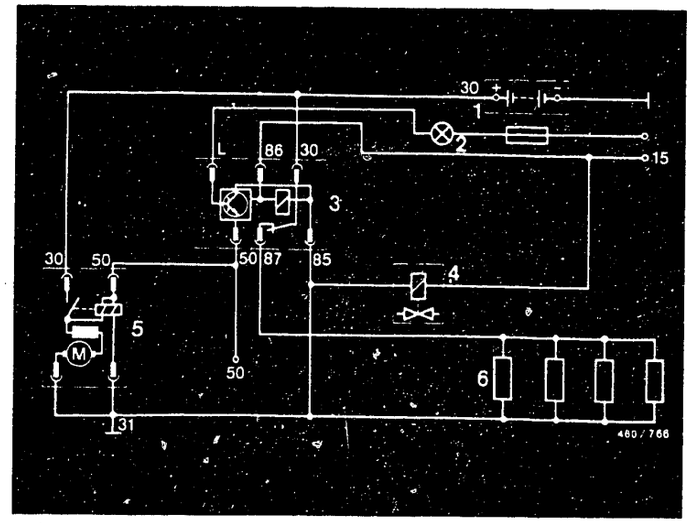
1. Check fuse No. 6 as well as lead from fuse to glow-plug warning lamp for pen circuit.
   Eliminate open circuit.

2. Check ground lead Term. 85 from glow-duration unit for open circuit.
   Eliminate open circuit.

3. Check for open circuit in ground lead from glow-duration unit Term. L to glow-plug warning lamp including bulb.
   Eliminate open circuit.

4. Check for open circuit in lead from glow-plug and starter switch Term. 15 to glow-duration unit Term. 86.
   Eliminate open circuit.

If points 1 ... 4 OK, replace glow-duration unit.



yes ↓

Continued on C23/C24

yes

Test power supply to R-type sheathed element glow-plugs. no

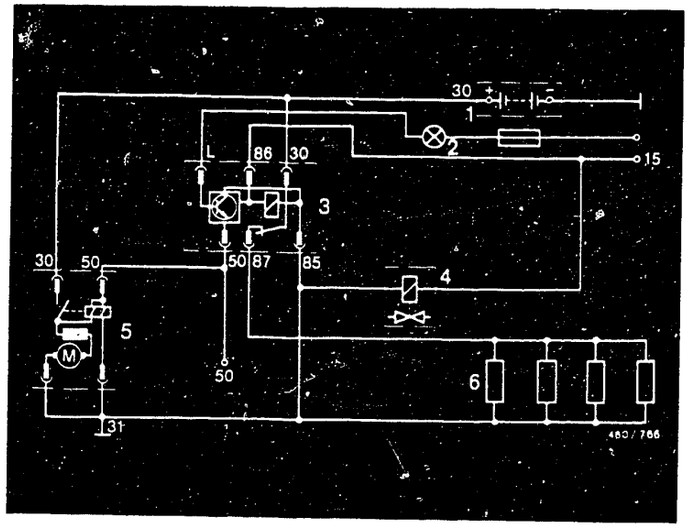
Connect test lamp to R-type sheathed-element glow plug and to ground.

Turn glow-plug and starter switch to preheating.

Test lamp lit?

1. Check lead from R-type sheathed-element glow-plugs to glow-duration unit Term. 87 for open circuit. Eliminate open circuit.
2. Check lead Term. 30 from glow-duration unit to battery Term. 30 for open circuit. Eliminate open circuit.

If points 1 and 2 OK, replace glow-duration unit.



yes

Check power supply to glow-duration unit when starting motor is operated. no

Connect test lamp to Term. 50 on glow-duration unit.

Turn glow-plug and starter switch to "start" position.

Test lamp lit?

Check for open circuit in connecting lead from glow-plug and starter switch Term. 50 to glow-duration unit Term. 50. Eliminate open circuit.

yes

Continued on D1/D2

yes

Check R-type sheathed-element glow plugs

Check R-type sheathed-element glow plugs individually for continuity using Ohmmeter.
OK?

no → Replace R-type sheathed-element glow plugs (tightening torque 40 Nm).

yes

Check current to glow plugs using VA tester ETT 011.00:

- Connect ammeter (e.g. ETT 011.00) into lead to glow plugs.
- Turn glow-plug and starter switch to "preheating".
- Read off current consumption.

Set value: approx 50 A

Set value reached?

no →

Note:

Current consumption approx 12 A per glow plug after stabilization. In the case of a current consumption of the glow plug of approx

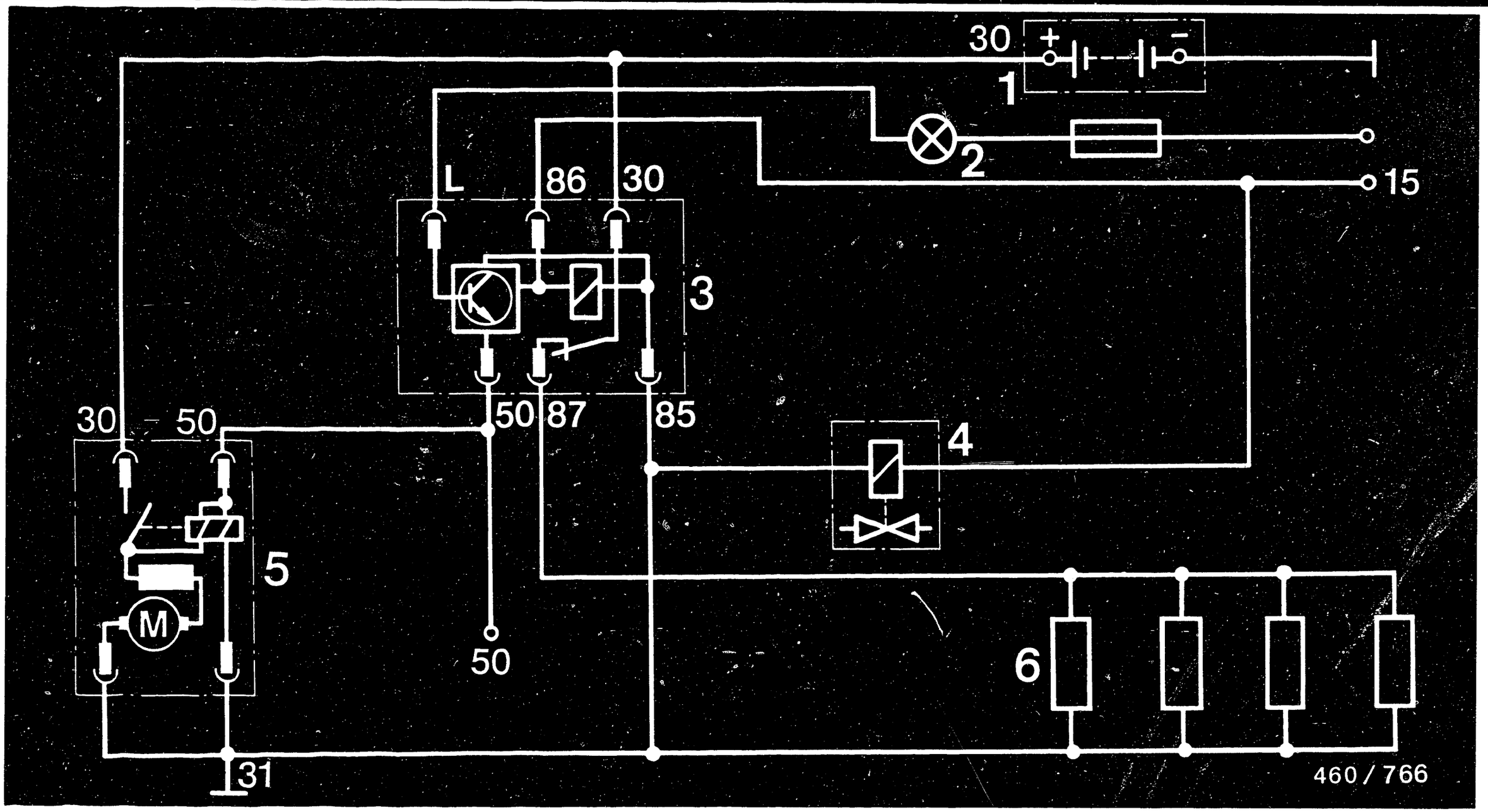
36 A = one glow plug defective
24 A = two glow plugs defective
12 A = three glow plugs defective

These current readings are reached only with a battery voltage of above 12.0 V.

yes

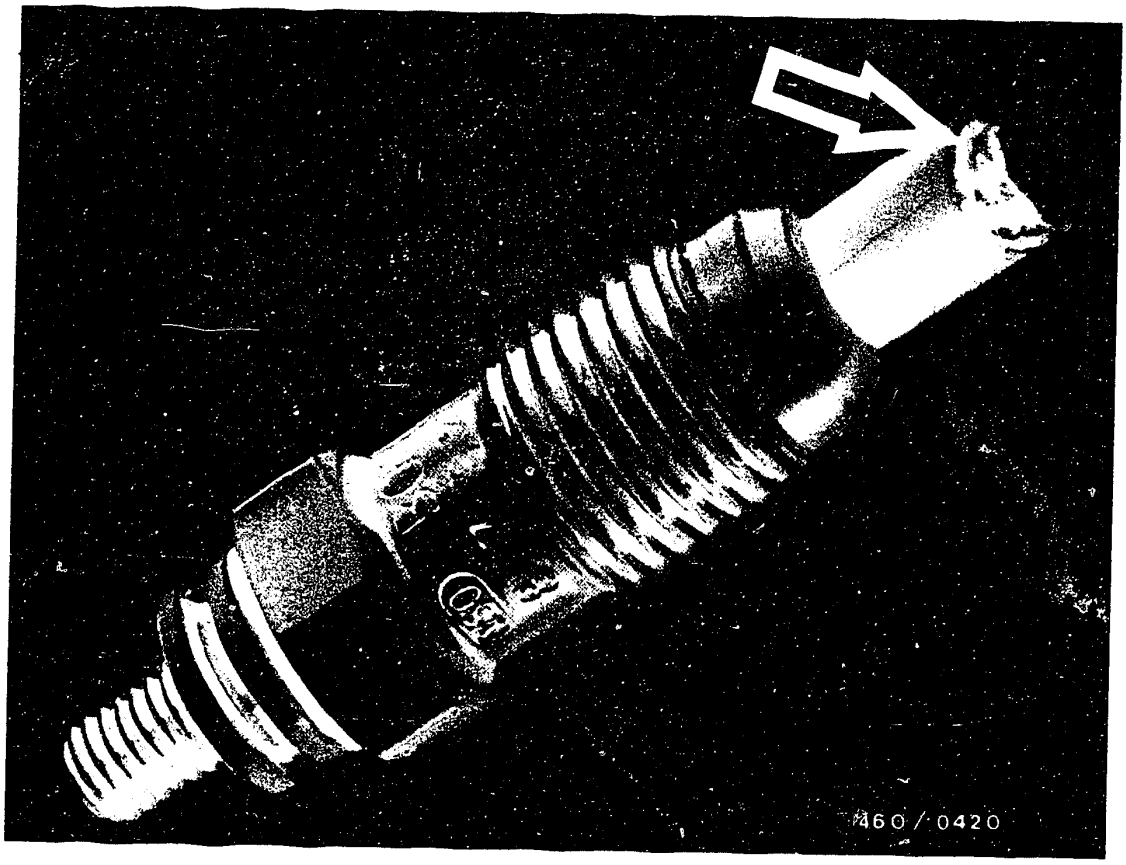
Preheating system OK.
(Fault is in fuel supply).

Installation position of glow-duration unit



1 = Battery
2 = Glow-plug indicator lamp
3 = Glow-duration unit
4 = Solenoid-operated valve
5 = Starting motor
6 = Sheathed-element glow plugs

22.3 Connection diagram for preheating system



Note:

Glow plugs with burned elements

Glow plugs with burned elements are frequently the result of troubles with the injection nozzle.

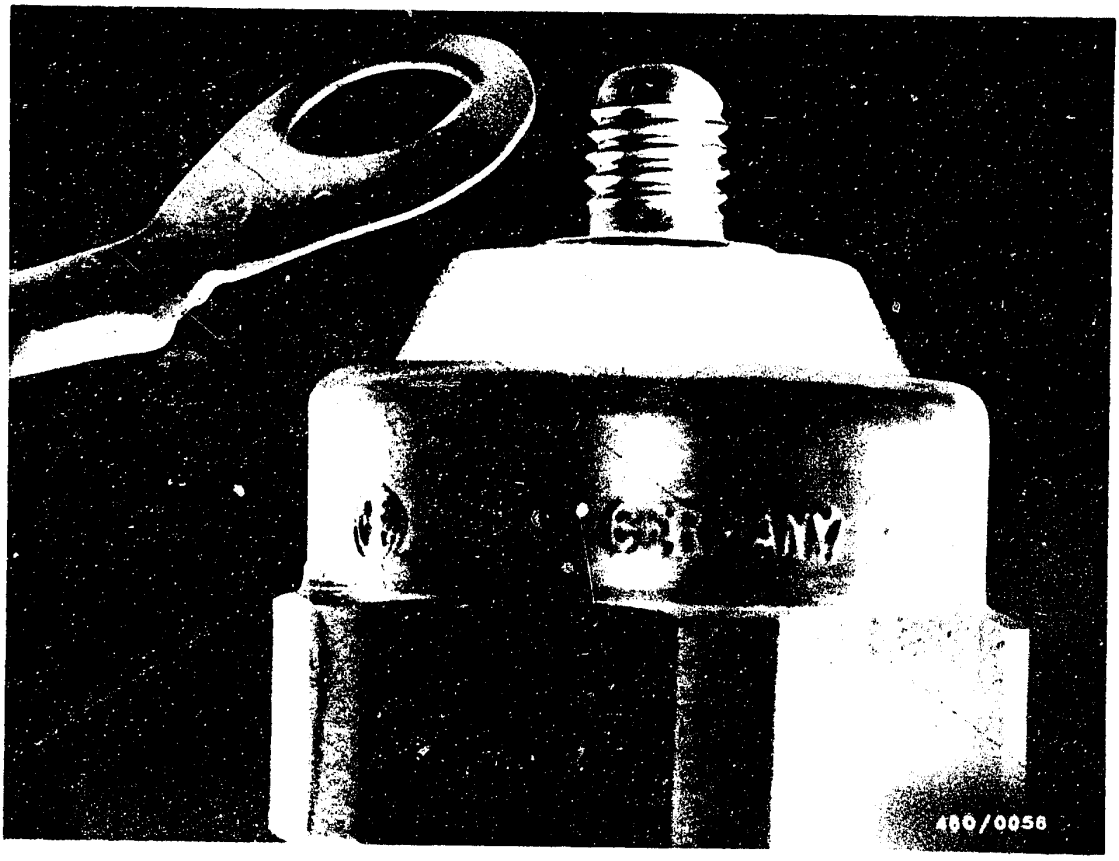
If glow plugs are found to have burned elements (arrow), it is not sufficient simply to replace them. The injection nozzles must also be tested for spray pattern, chattering, pressure and leaks.

23.1 Check timing device

In distributor-type fuel-injection pumps VE..F.. the timing device is integral with the fuel-injection pump.

In order to test the timing device, it is necessary to remove the fuel-injection pump.

Perform the test on the injection-pump test bench.



24. Measure engine compression and compression loss

24.1 Measure engine compression

Fit new chart in compression tracer. Mount high-pressure hose on tracer. Switch off engine.
In order to prevent fuel from being injected, remove connecting cable from shutoff magnet on distributor-type fuel-injection pump (picture).

Unscrew sheathed-element glow plugs and select suitable connecting nipple for compression tester.

Using the starting motor, turn over the engine several times so that loose deposits are removed from the combustion space.

Screw in connection nipple.

Fit high-pressure hose of compression tester onto connection nipple.

During the following operation, note first compression stroke.

Operate starting motor until there is no longer any detectable rise in pressure on the compression tracer.

Bleed compression tracer by pressing on bleeder valve.

The pointer returns to the starting position.

Move chart onto next position.

Fit connection nipple to the other cylinders and repeat measurement.

Compression pressure: 20 ... 30 bar
minimum: 17 bar

24.1.1 Evaluation of chart

1. Normal pressure rise

If piston rings and valves are in good condition, the first compression stroke shows the highest pressure increase.
During the following compression strokes the compression builds up to the maximum pressure.

2. Gradual pressure rise

If, from the start, the compression increases only gradually on each piston stroke, this points to burnt valve seats or defective valve guides.

3. Low maximum pressure

If the maximum pressure obtained is too low on all cylinders, this points to defective pistons, piston rings or valves.
If the compression is too low on two neighbouring cylinders, this points to a leaky cylinder head gasket.

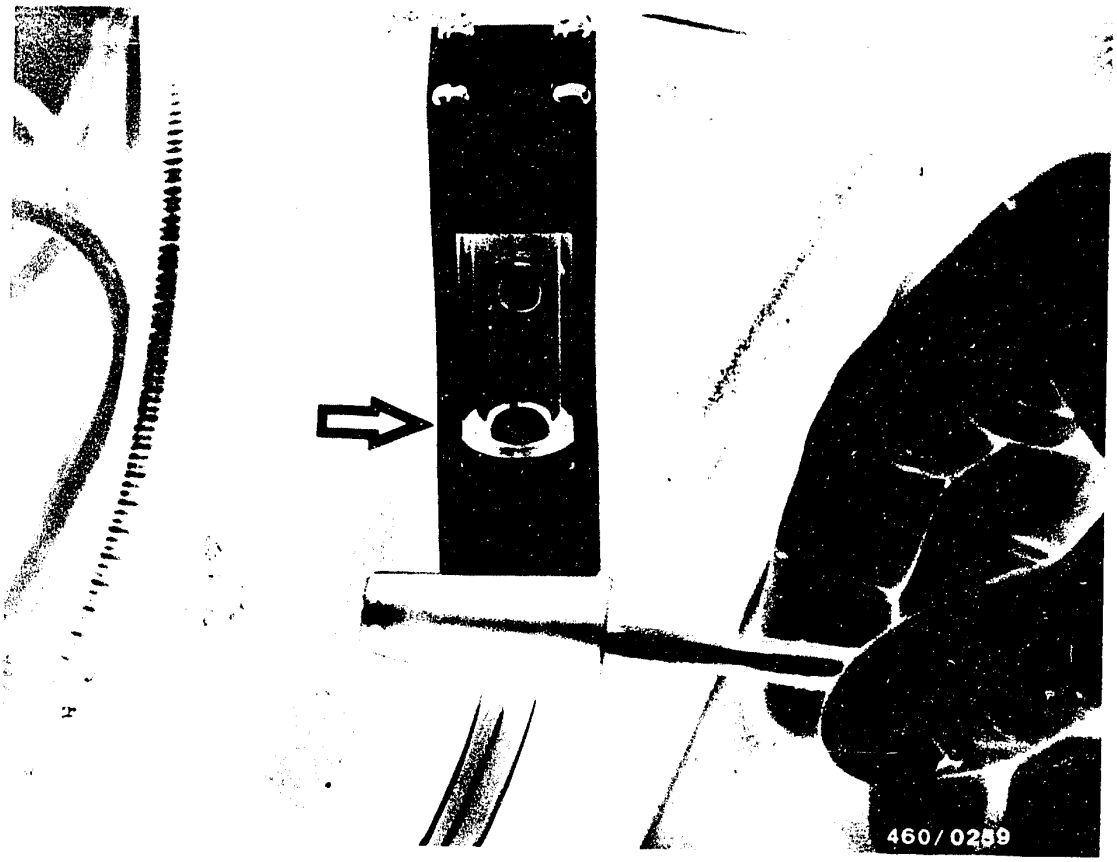
4. Varying compression

If one cylinder shows a clearly lower compression, proceed as follows: fill in 2-3 cm^3 of engine oil through the opening of the sheathed-element glow plug or nozzle-holder assembly and operate starting motor briefly.

Repeat measurements and compare charts. If there is a clear increase in compression during the second test, then the piston rings or cylinders are worn.
If there is no change in the result, then defective valves are the cause.

5. Uniform compression

Uniform compression is extremely important with regard to the smooth running of the engine. Maximum compression is, therefore, not the only objective.



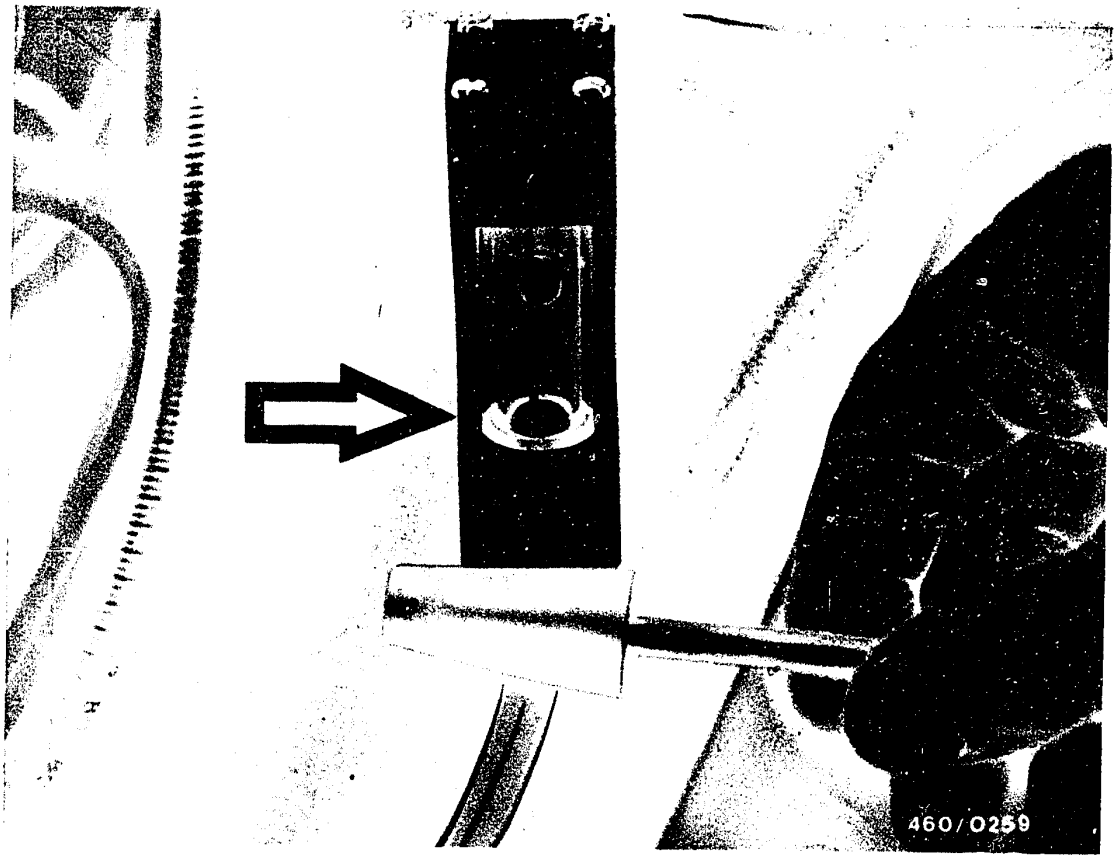
24.2 Measure compression loss of engine

The test is performed using the Bosch compression-loss tester 0 681 001 901 (EFAW 210 A).

The respective cylinder must be at TDC (TDC = top dead center) on the compression stroke.

For setting this point, use DC detector 1 688 132 025 (included in accessories with compression-loss tester).

Perform test with engine at normal operating temperature (temperature of water approx. 80°C).



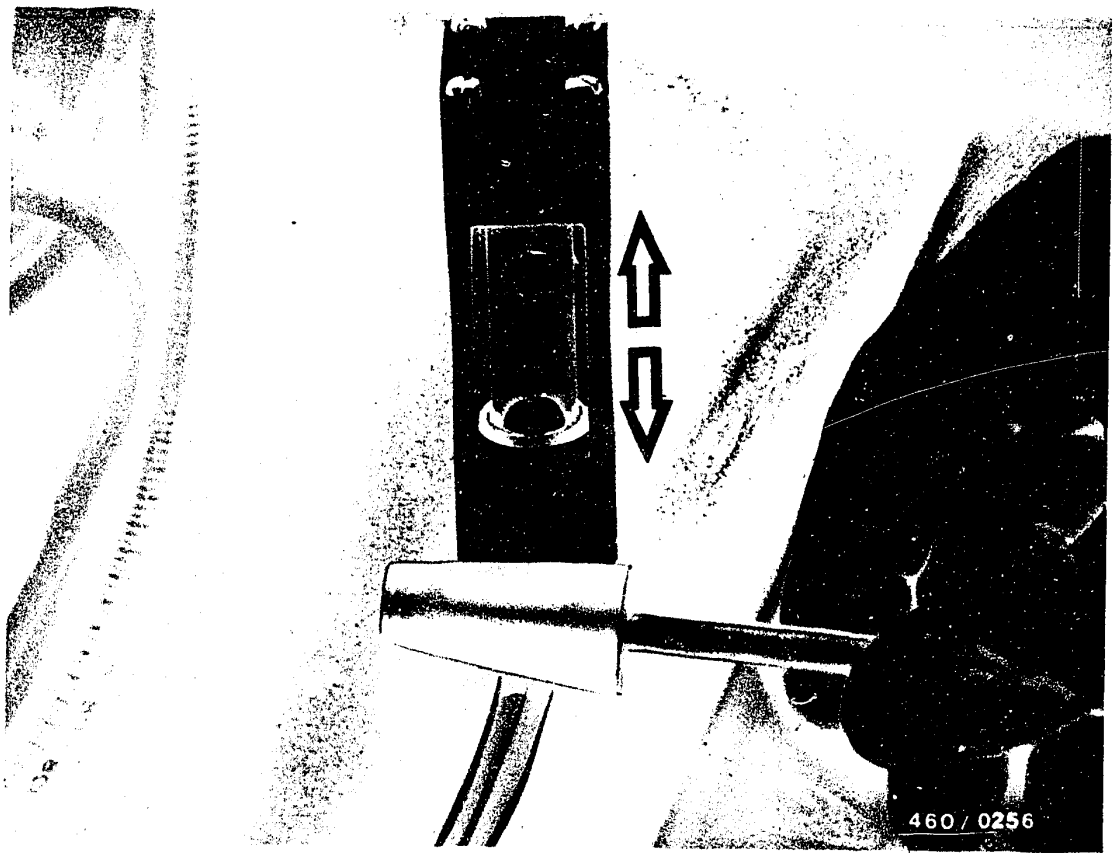
24.2.1 Set top dead centre

Remove sheathed-element glow plug from cylinder 1.

Insert rubber plug of DC detector into bore for sheathed-element glow plug.

Using magnetic clamp, mount glass cylinder in as vertical a position as possible in the engine compartment.
The piston of the unit must be easily visible.

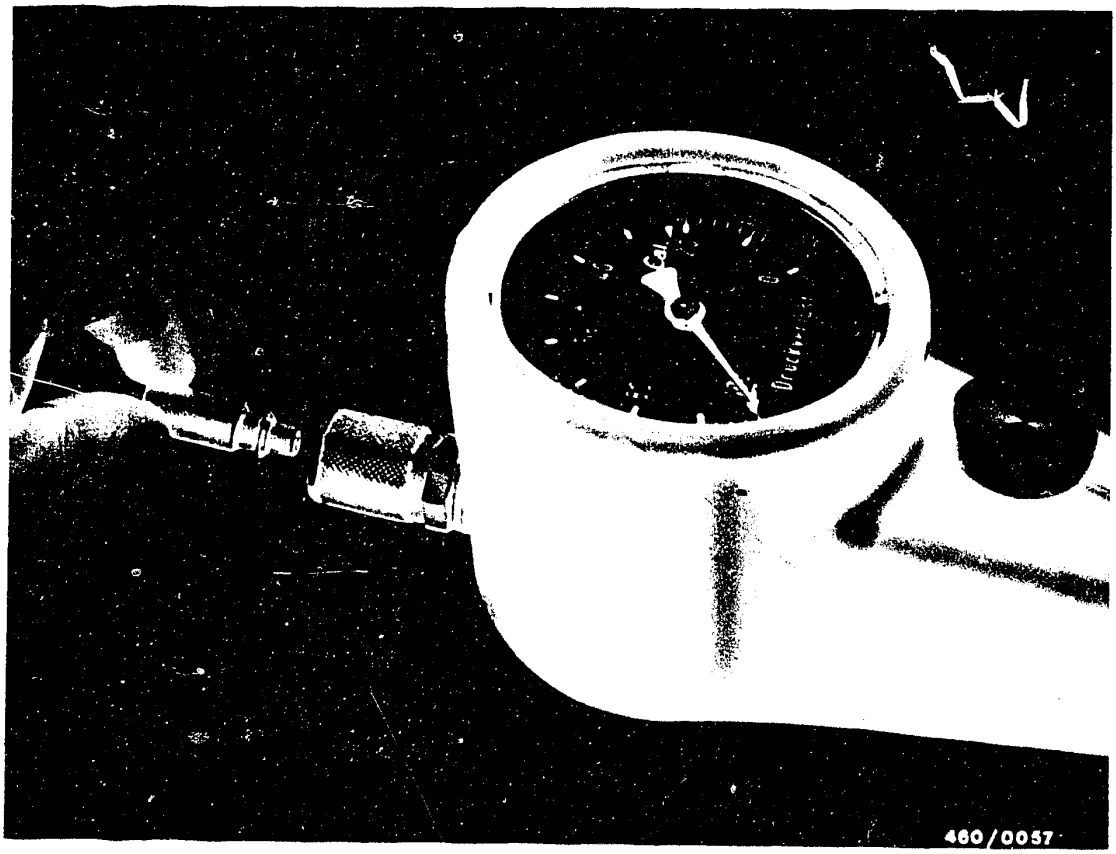
Slowly turn the engine over by hand in its direction of rotation.
(If necessary, select gear and push vehicle).



On the compression stroke, the piston of the DC detector is forced upward.

As top dead centre is passed over, the piston slides down again immediately.

Establish dead center by carefully turning the engine crankshaft backwards and forwards.

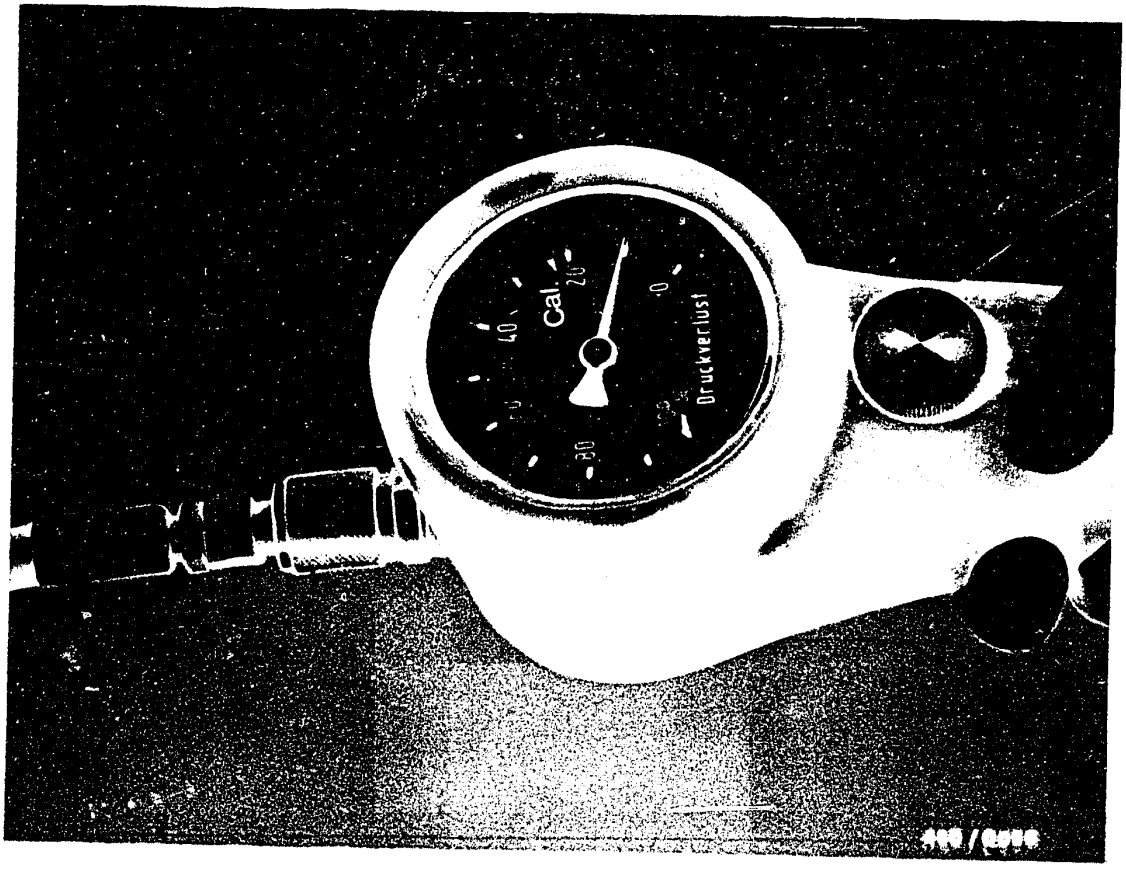


24.2.2 Measure compression loss

Connect tester to compressed-air mains.

Connect calibrating nozzle 1 680 363 036. Set a compression loss of 23 ± 1% (marking "Cal".) at the knurled thumbscrew on the pressure-regulating valve. Disconnect calibrating nozzle.

(Instrument indicator must show approximately 0% compression loss - equipment check.)



Screw in fitting and mount test hose.
Select gear and pull on handbrake.
Connect test hose to tester.
Read off compression loss in % on instrument.

Note:
Before testing the next cylinder, turn the engine over briefly without pre-heating using the starting motor sc. that the oil film re-forms.

24.2.3 Evaluation of test

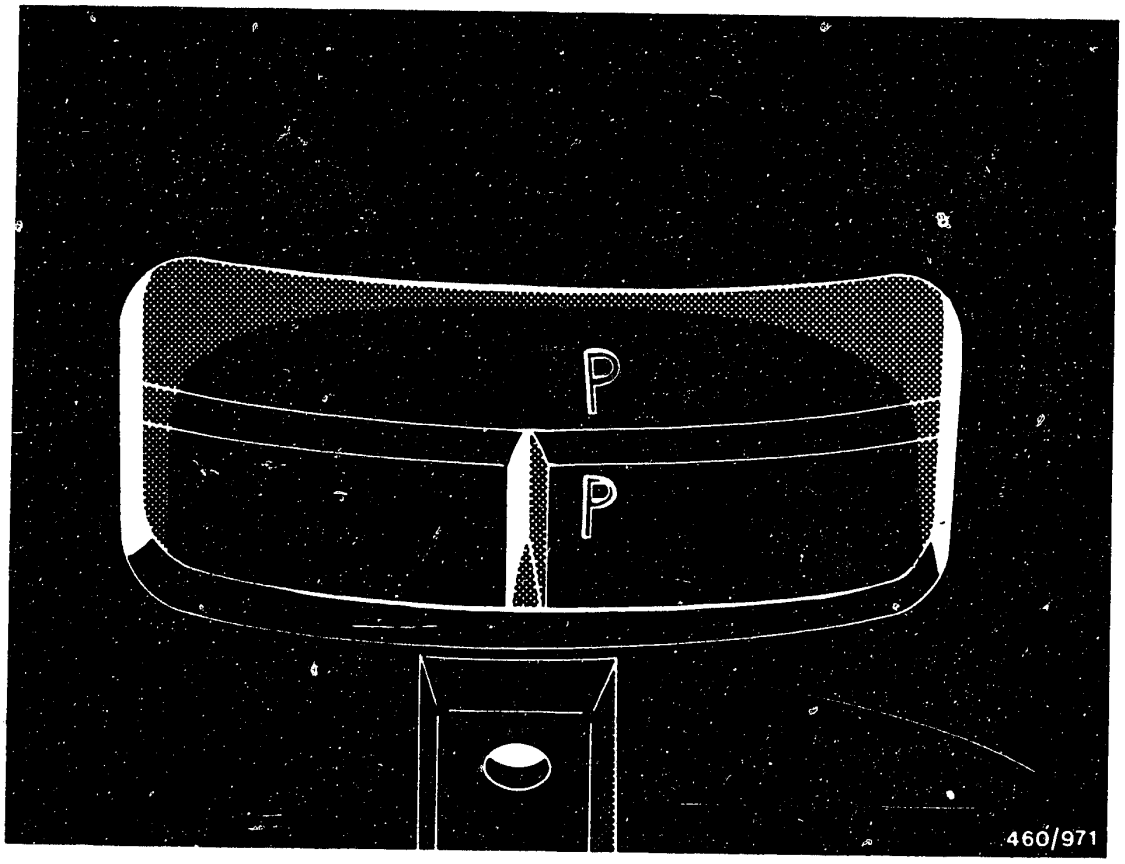
The compression loss indicated should not exceed 25%.

Differences of 10% between the individual cylinders can be ignored.
The causes of greater losses can be located because the air makes a noise as it escapes.
Listen at the following points:

Location of noise	Possible trouble
Intake manifold (remove air filter)	Intake valve
Exhaust manifold	Exhaust valve
Oil filler neck on engine	Pistons, piston rings
Cooling water filler neck (air bubbles)	Cylinder head gasket

In order to trace the trouble even more accurately, fill approximately 2-3 cm^3 of engine oil into the cylinder. Repeat test.
If there is a clear decrease in compression loss during this test, then the fault lies with the piston or with the piston rings.

New engines which have not yet been run in (less than 5,000 km) may show higher compression losses than after the running-in period.



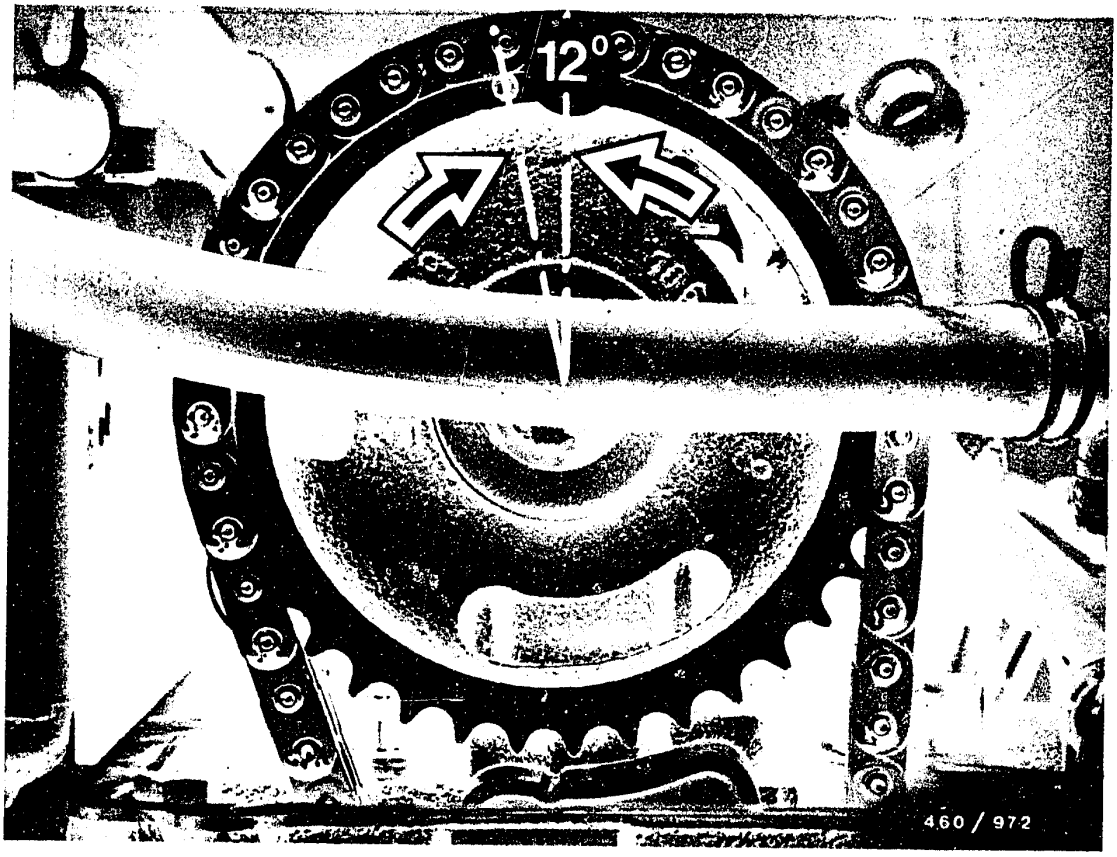
25. Remove fuel-injection pump

Disconnect negative cable from battery.

Remove cylinder head cover.

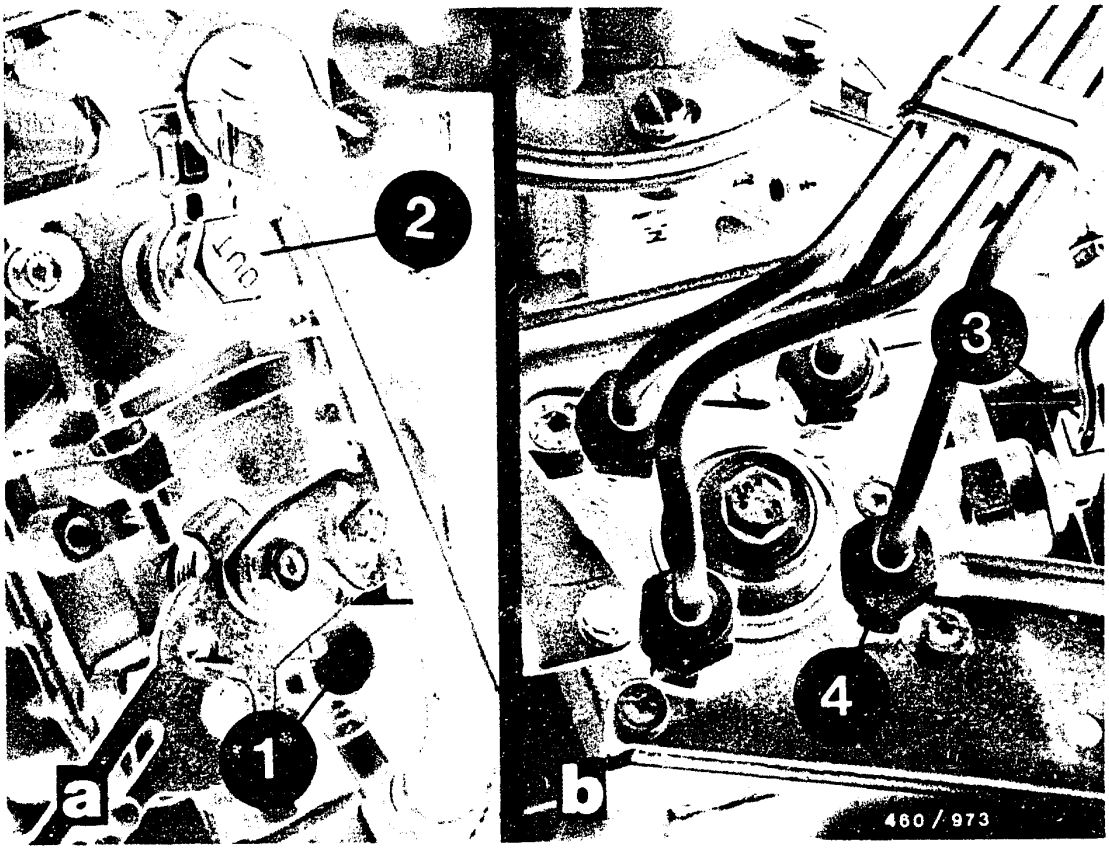
Turn crankshaft in direction of rotation until reference mark on clutch housing aligns with mark "P" on fly wheel.

Cylinder 1 on compression stroke (valves of cylinder 4 start to overlap).



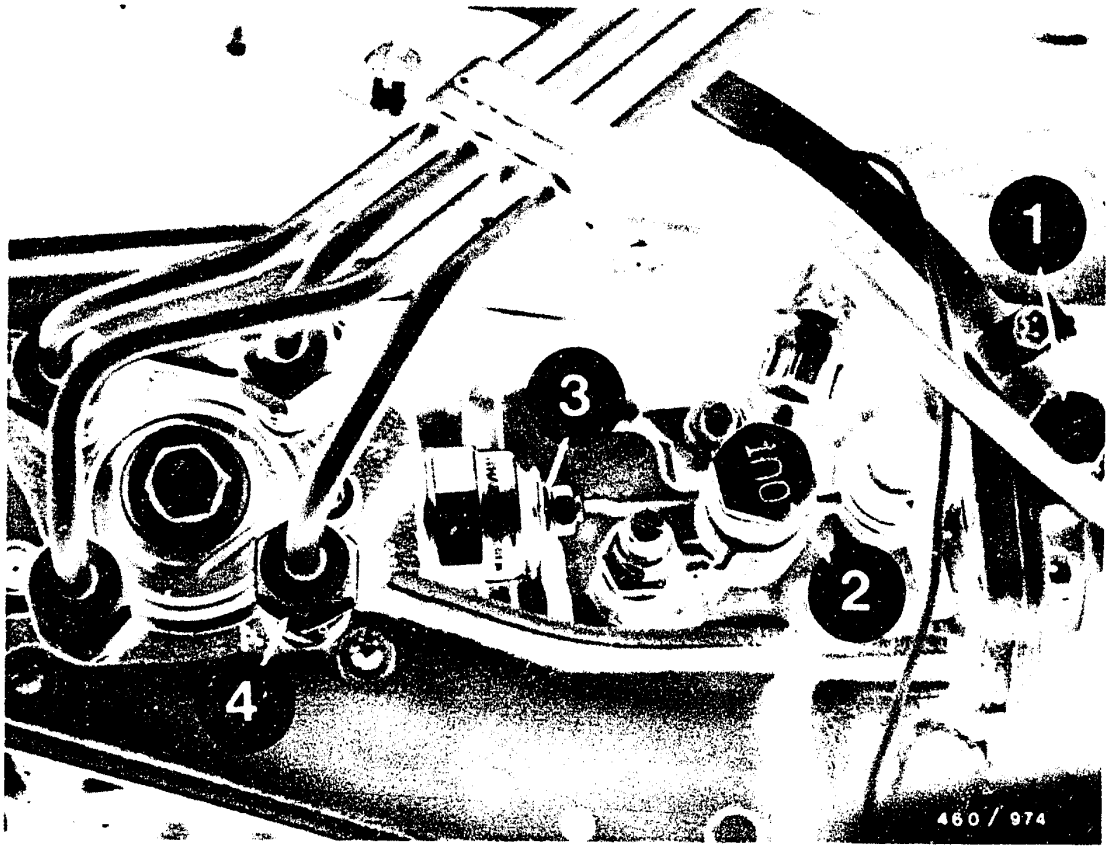
Piston of cylinder 1 is 24° before TDC.

Mark on camshaft gear approx 12° before the highest point of rotation.



2.0 D; 2.1 D; 2.3 D

Remove fuel inlet line (1), return line (2), lead for electrical shutoff device (3) and injection lines (4). (Prevent delivery-valve holders from coming loose by holding with a wrench).

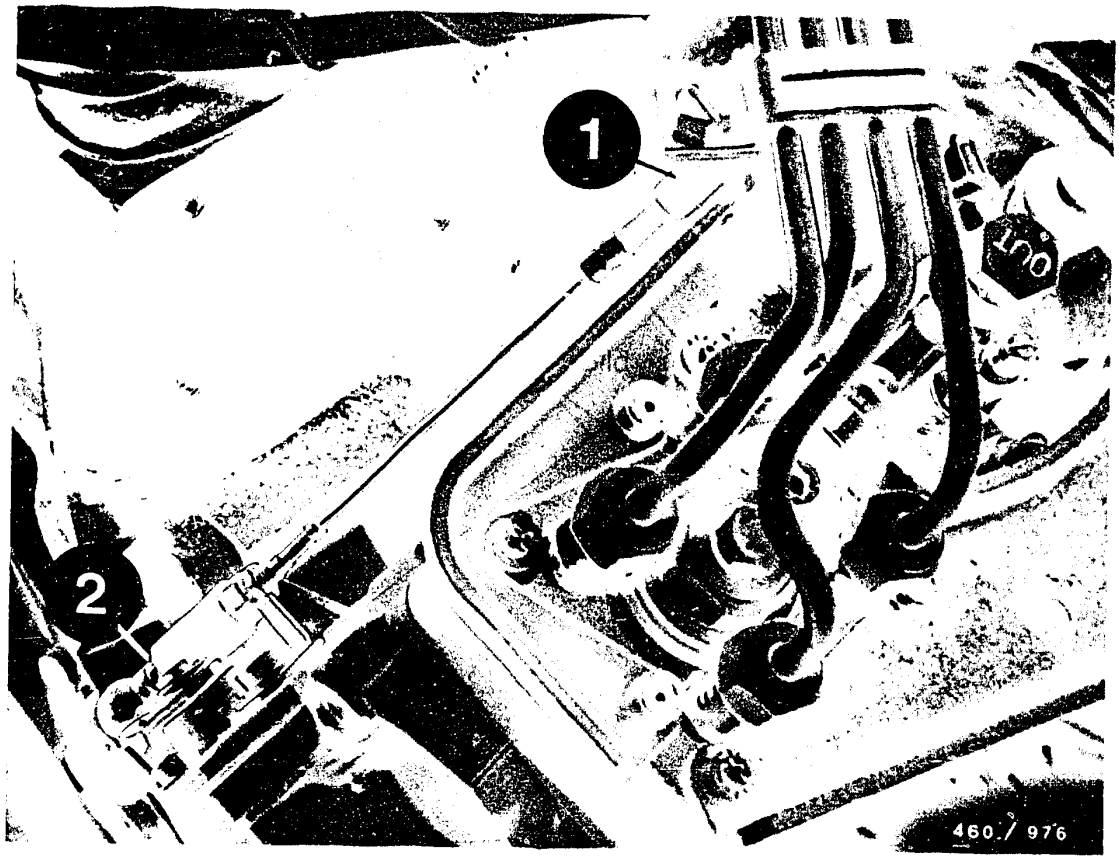


2.3 Turbo diesel

Remove charge-air pressure connection (1), fuel return line (2), lead for electrical shutoff device (3) and injection lines (4).
(Prevent delivery-valve holders from coming loose by holding with a wrench.

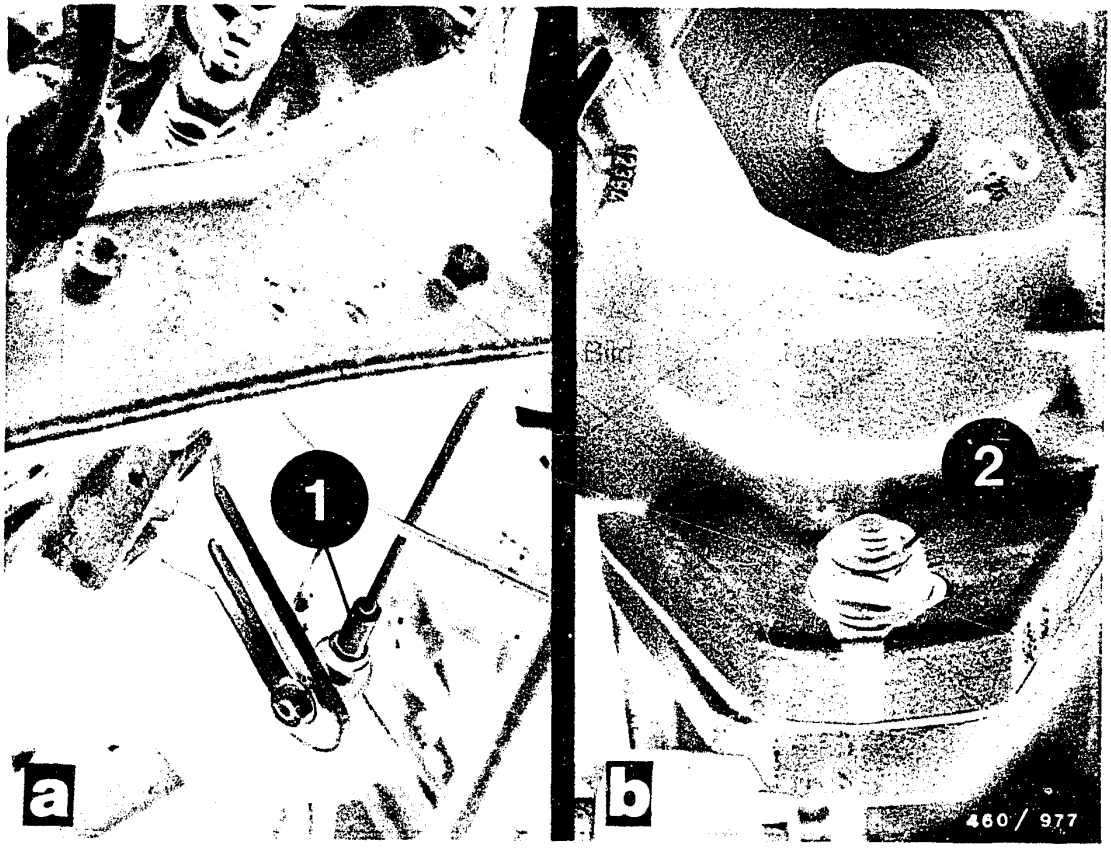
2.3 Turbo diesel

Unscrew fuel inlet line at pipe fitting (arrow).



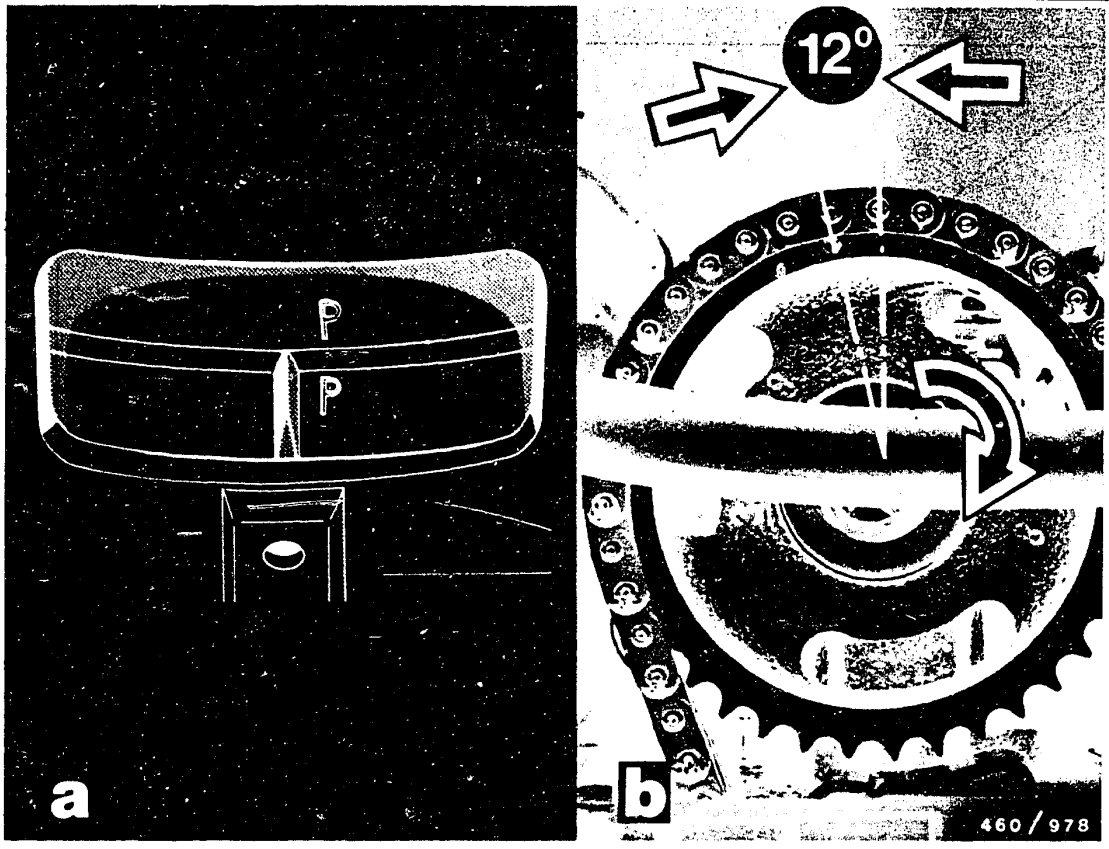
Remove fastening clamp of KSB *Bowden cable from bracket (1) and unhook cable from injection-pump control lever (2).

*KSB = cold-start accelerator



Remove Bowden cable from control lever (1) and remove injection-pump fastening nuts (2).

Pay attention to toothed sleeve when removing fuel-injection pump.



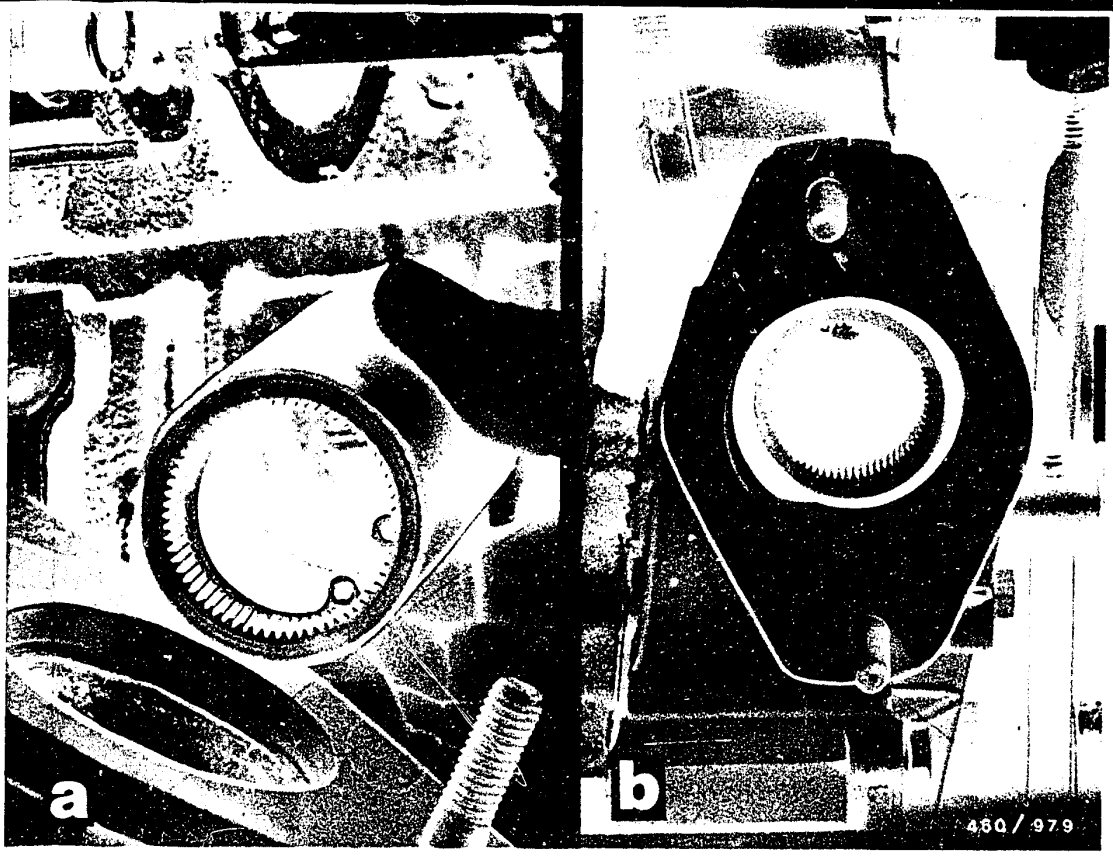
26. Install fuel-injection pump

Check position of crankshaft.

Reference mark on clutch housing must line with mark "P" on flywheel (picture a).

Mark on camshaft gear approx 12° before the highest point of rotation (picture b).

Picture b - arrow = direction of engine rotation

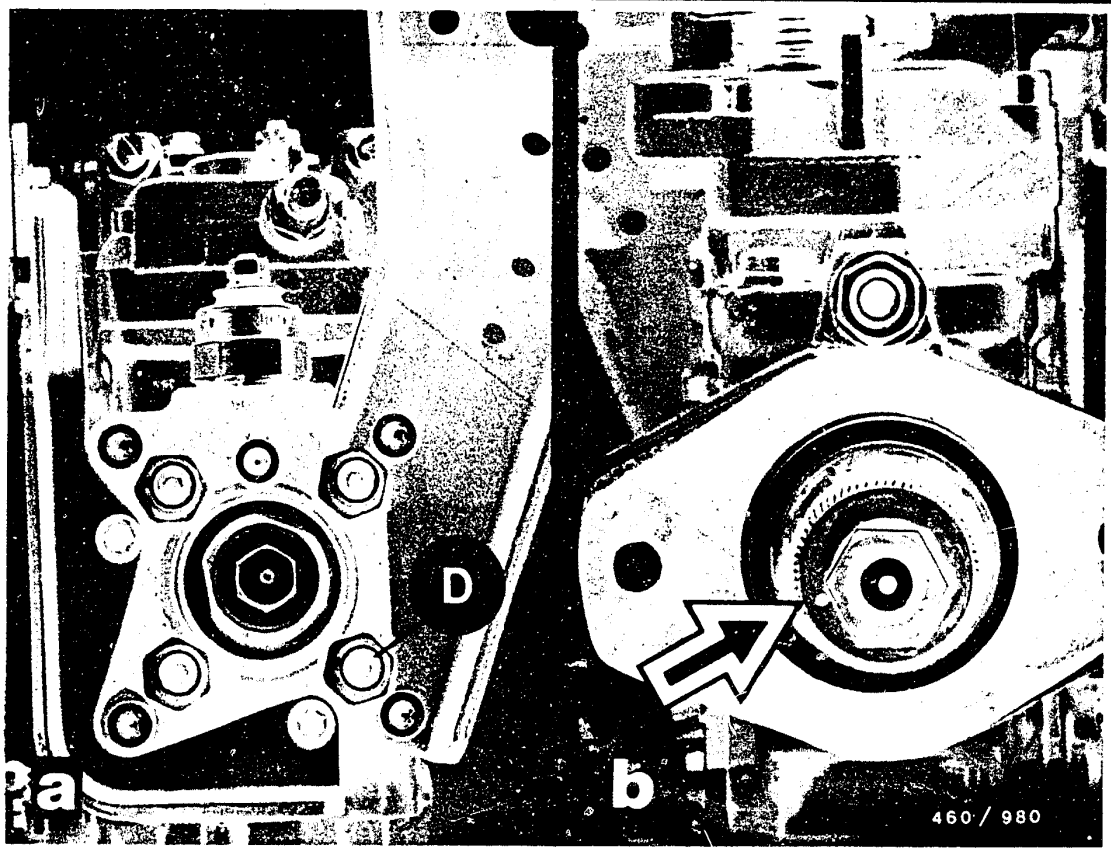


Insert toothed sleeve - with the retainer at the bottom - in control housing (picture a).

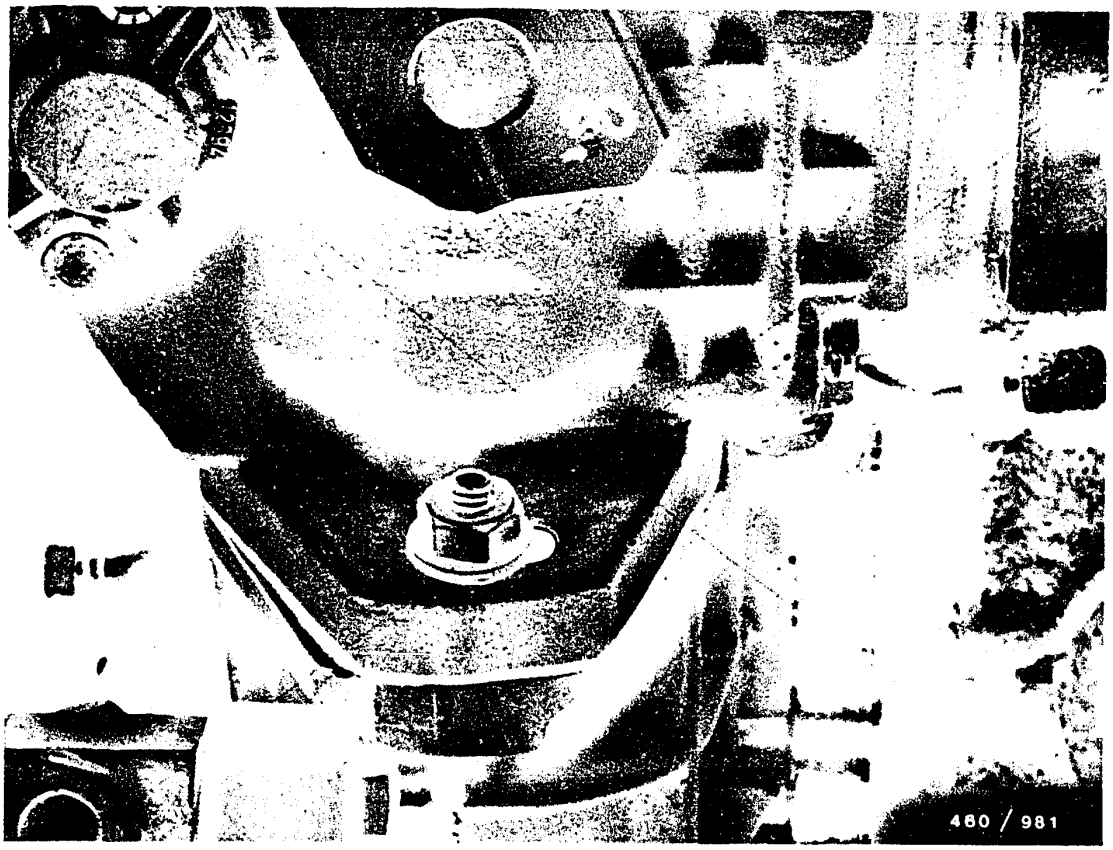
Note:

Make sure that the retainer is correctly seated.

Installation position of toothed sleeve when inserted (picture b).



Before inserting the injection pump into the control housing, bring mark on drive pinion (picture b - arrow) into alignment with outlet "D" (picture a).

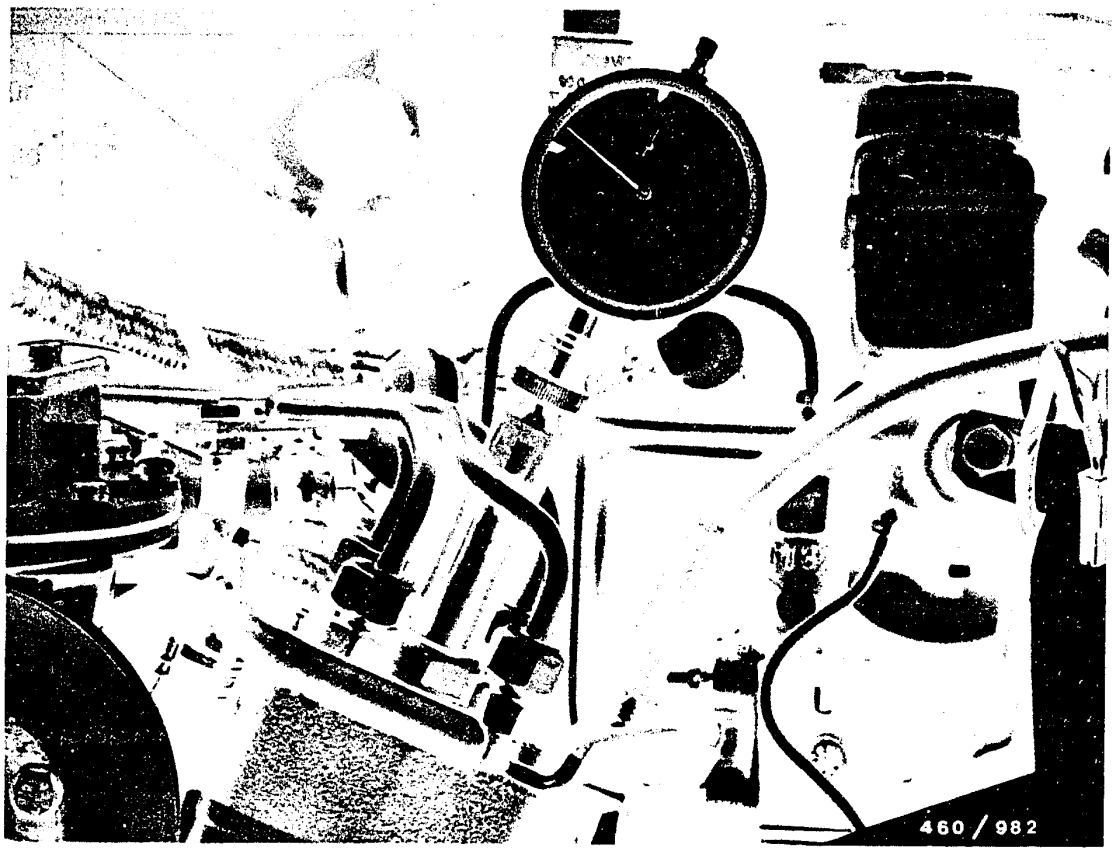


Insert fuel-injection pump.

Note:

When inserting the injection pump, the stay bolts in the control housing must be up against the end of the slots of the pump flange. (Outer stay bolt up against left-hand end of slots, inner stay bolt up against right-hand end of slots, see picture).

Finger-tighten fastening nuts.



Unscrew bleeder screw out of central screw plug (triangular plug) of hydraulic head.

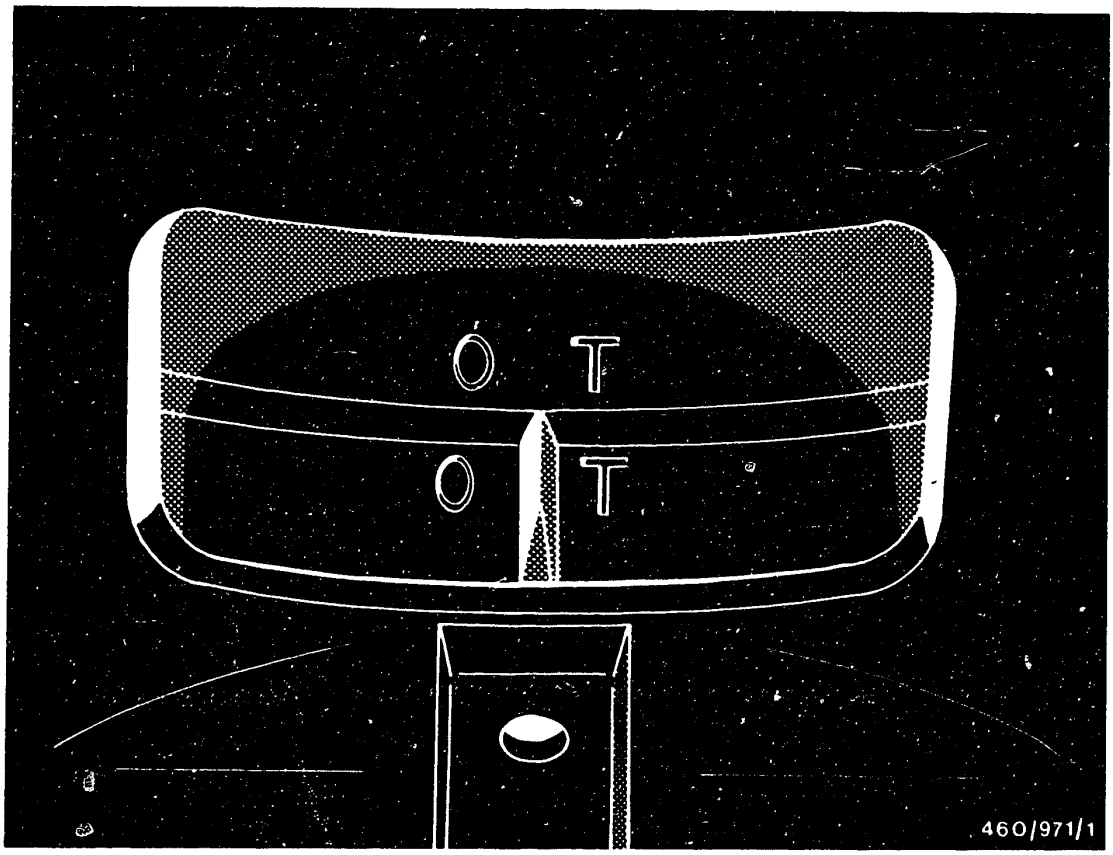
Insert measuring tool KDEP 1126 with dial indicator into tapped hole.

Preload dial indicator by approx 3 mm.

Slowly turn crankshaft against engine direction of rotation until the pointer of the dial indicator no longer moves.

Set dial indicator to "0".

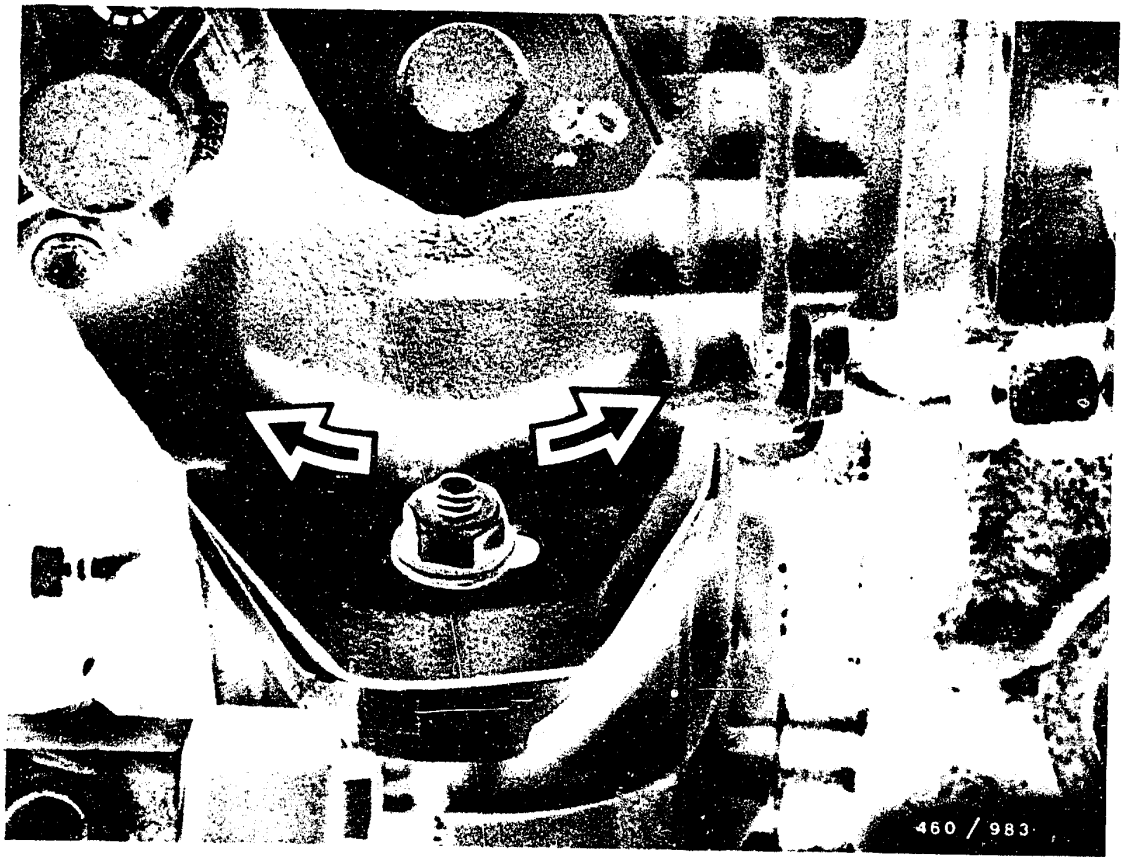
When checking and setting the start of delivery, the cold-start accelerator must be in the zero position.



Turn crankshaft in engine direction of rotation until TDC mark (OT) on flywheel aligns with reference mark on clutch housing.
If you turn past the "TDC" (OT) mark, turn back again beyond "OT" point, and then turn again to "OT".
With the piston in this position, the dial indicator on the injection pump must indicate the correct value for the engine.

2.0 D with VE..L28	1.07 ± 0.05 mm after BDC	(*1.30)
2.1 D with VE..L27	0.95 ± 0.05 mm after BDC	
2.1 D with VE..L12	0.88 ± 0.05 mm after BDC	
2.3 D with VE..L37	0.93 ± 0.05 mm after BDC	(*1.24)
2.3 D with VE..L128	0.93 ± 0.05 mm after BDC	
2.3TD with VE..L156	0.85 ± 0.05 mm after BDC	

* With modified timing-device cover



If a correction is necessary, loosen injection-pump fastening screws and set the respective stroke by pivoting.

2.0 D with VE..L28	1.07 ± 0.05 mm after BDC	(*1.30)
2.1 D with VE..L27	0.95 ± 0.05 mm after BDC	
2.1 D with VE..L12	0.88 ± 0.05 mm after BDC	
2.3 D with VE..L37	0.93 ± 0.05 mm after BDC	(*1.24)
2.3 D with VE..L128	0.93 ± 0.05 mm after BDC	
2.3TD with VE..L156	0.85 ± 0.05 mm after BDC	

* With modified timing-device cover

Checking the adjustment

Turn crankshaft back against engine direction of rotation until the pointer of the dial indicator no longer moves.

Set dial indicator to "0".

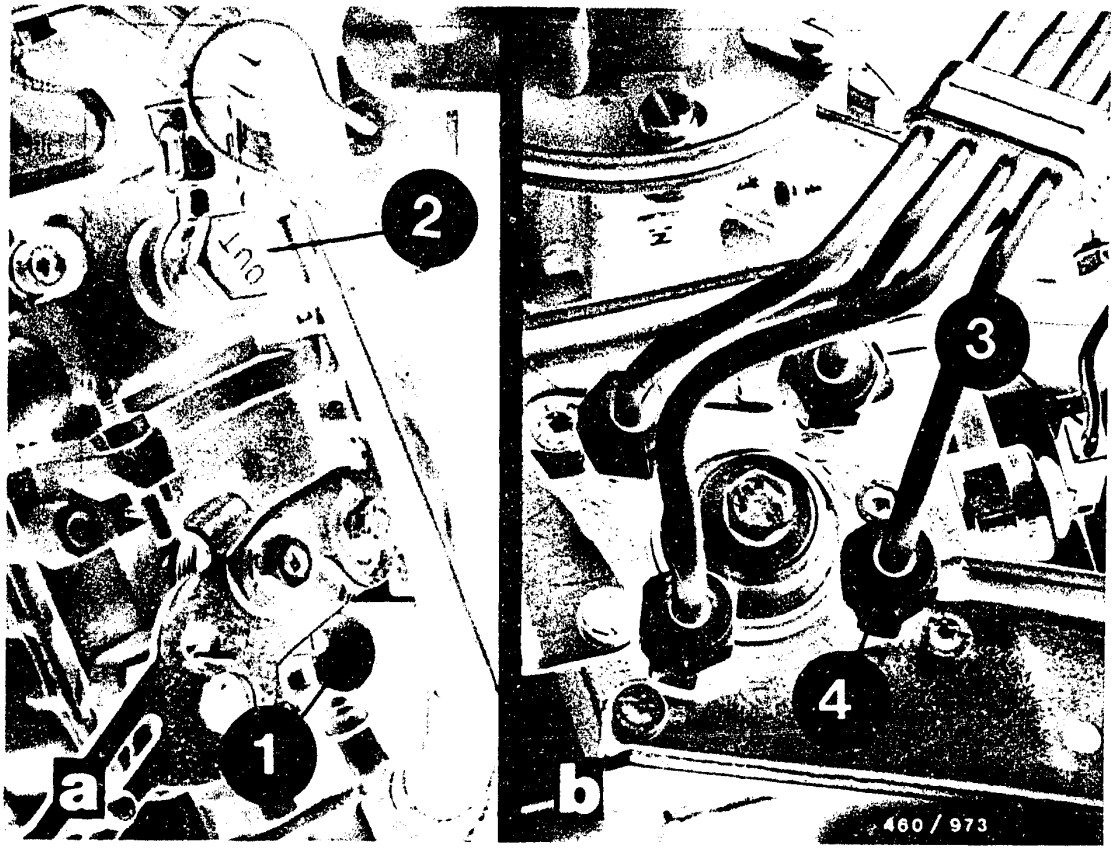
Turn crankshaft in engine direction of rotation until dial indicator indicates the setting value.

With the pump plunger in this position, TDC (OT) mark on flywheel must align with reference mark on clutch housing.

Tighten fastening nuts to 25 Nm.

Remove measuring tool KDEP 1126 with dial indicator.

Mount bleeder screw on injection pump with new seal ring.



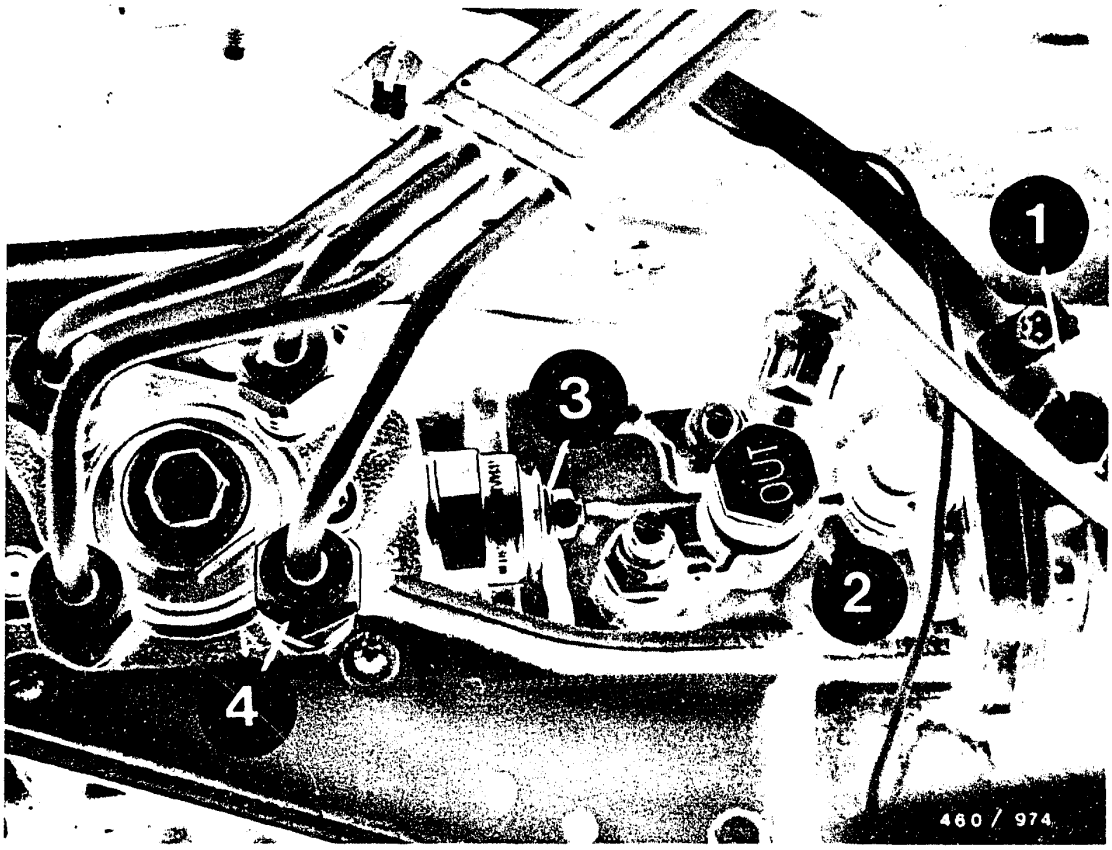
2.0 D; 2.1 D; 2.3 D

Mount fuel inlet line (1), return line (2), lead for electrical shutoff device (3) and injection lines (4). (Prevent delivery-valve holders from turning by holding with a wrench).

Hook in bowden cable of cold-start accelerator and speed -control lever.

Connect negative cable to battery and mount cylinder head cover.

Note:
Do not mix up the inlet-union screws of the fuel inlet and return lines.
The inlet-union screw of the return is provided with restriction bores and the head of the screw is marked "out".



2.3 Turbo diesel

Mount charge-air pressure connection (1), fuel return line (2), lead for electrical shutoff device (3) and injection lines (4).
(Prevent delivery-valve holders from turning by holding with a wrench).

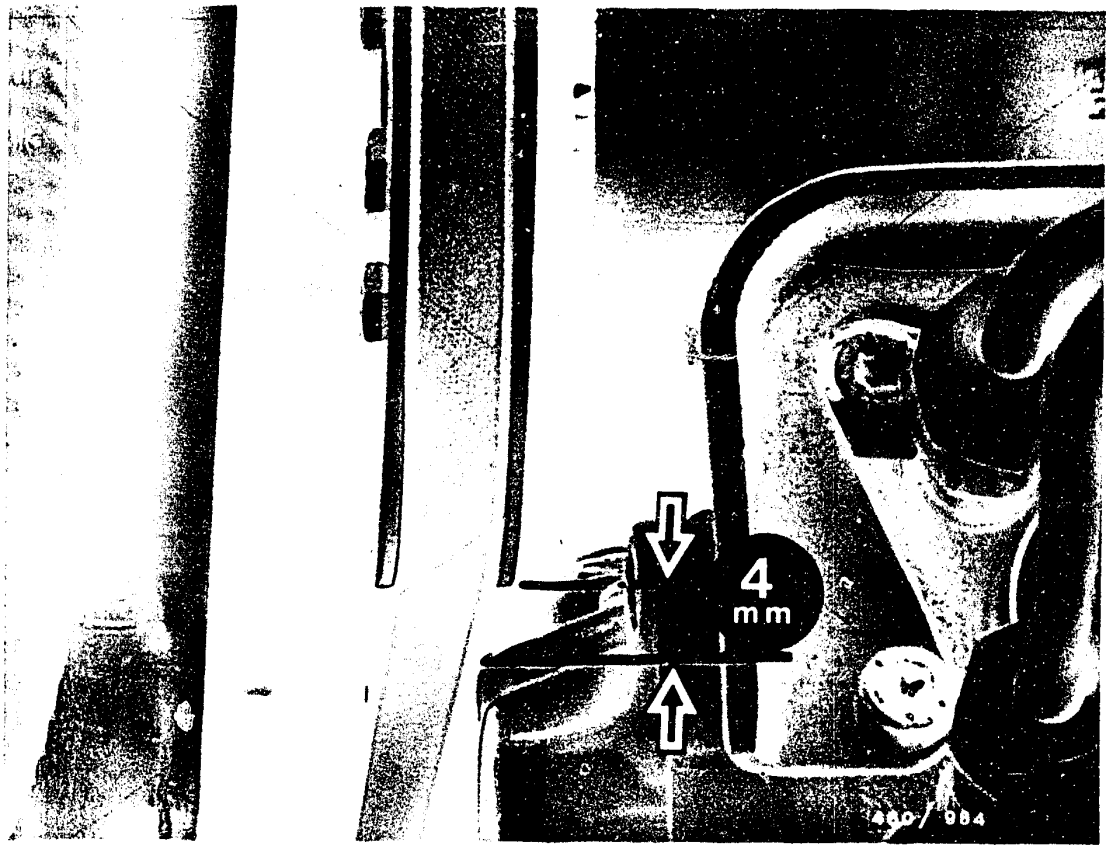
Note:
Do not mix up the inlet-union screws of the fuel inlet and return lines.
The inlet-union screw of the return is provided with restriction bores and the head of the screw is marked "out".

2.3 Turbo diesel

Mount fuel inlet line on pipe fitting (arrow).

Hook in bowden cable of cold-start accelerator and speed-control lever.

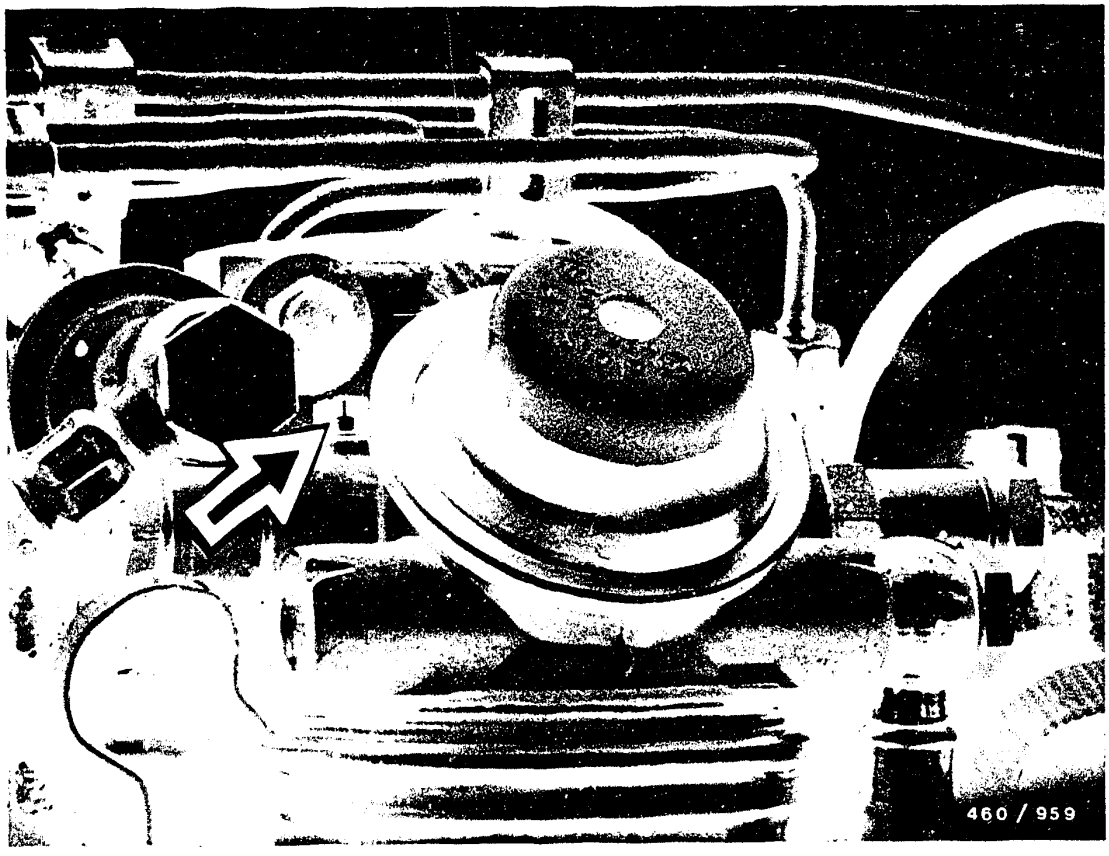
Connect negative cable to battery and mount cylinder head cover.



Note on installation: (does not apply to 2.3 l turbo-diesel)

After setting the start of delivery, there must be a minimum gap of 4 mm between timing-device cover and V-belt of vacuum pump.

If the gap is smaller, turn crankshaft back to position "P".
Unscrew injection-pump fastening nuts and lift injection pump until drive pinion comes out of engagement.
Pivot injection pump to the left and re-insert one tooth later.
Repeat setting of start of delivery. After setting, the stay bolt should be as near as possible to the left-hand slot.



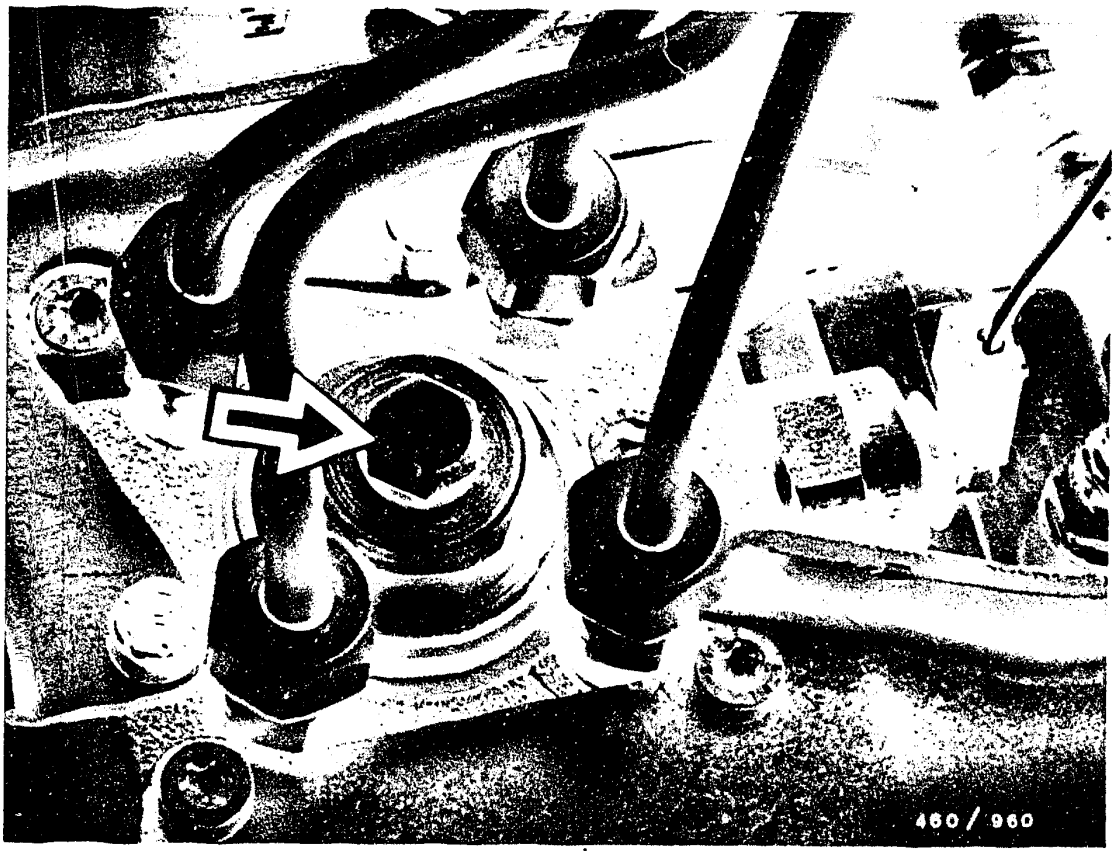
Bleed fuel system

Loosen bleeder screw on fuel filter (arrow).

Operate hand primer on fuel filter until fuel escaping from the bleeder screw is free of bubbles.

Tighten bleeder screw.

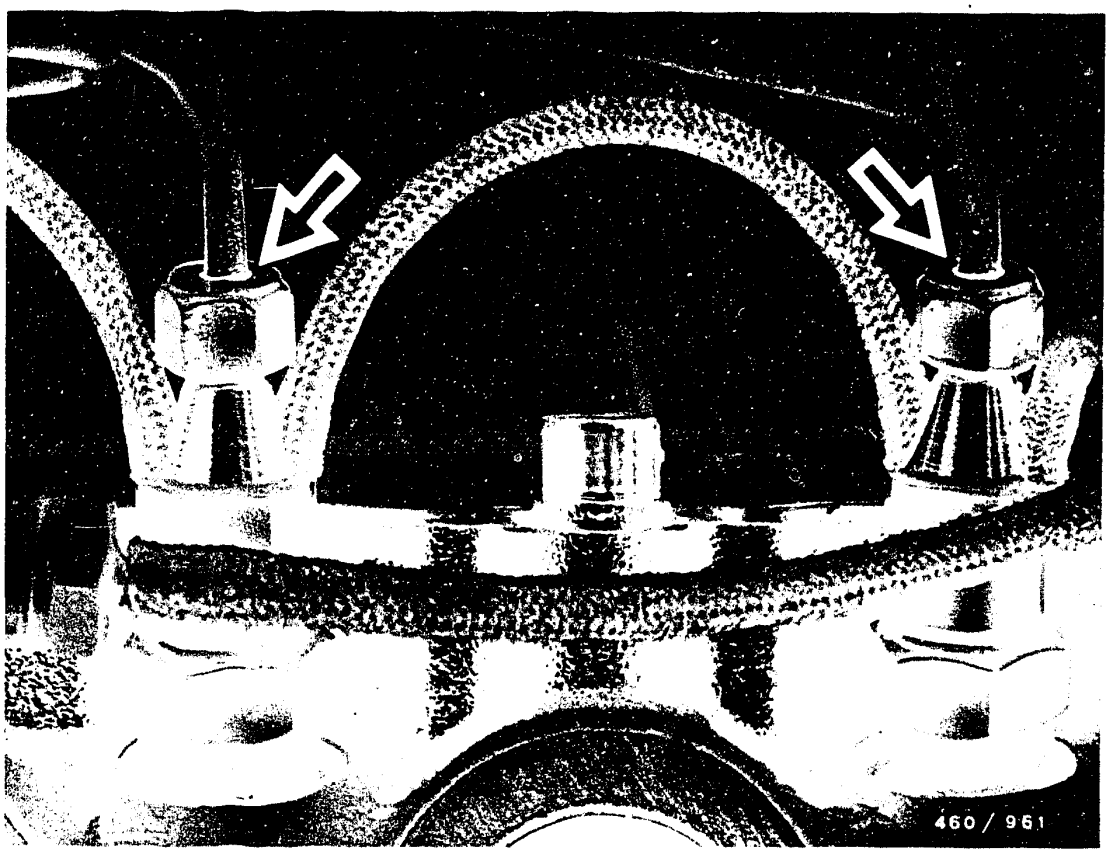
Continue to operate hand primer until resistance can be felt.



Loosen bleeder screw on fuel filter (arrow).

Operate hand primer on fuel filter until fuel escaping from the bleeder screw is free of bubbles.

Tighten bleeder screw.



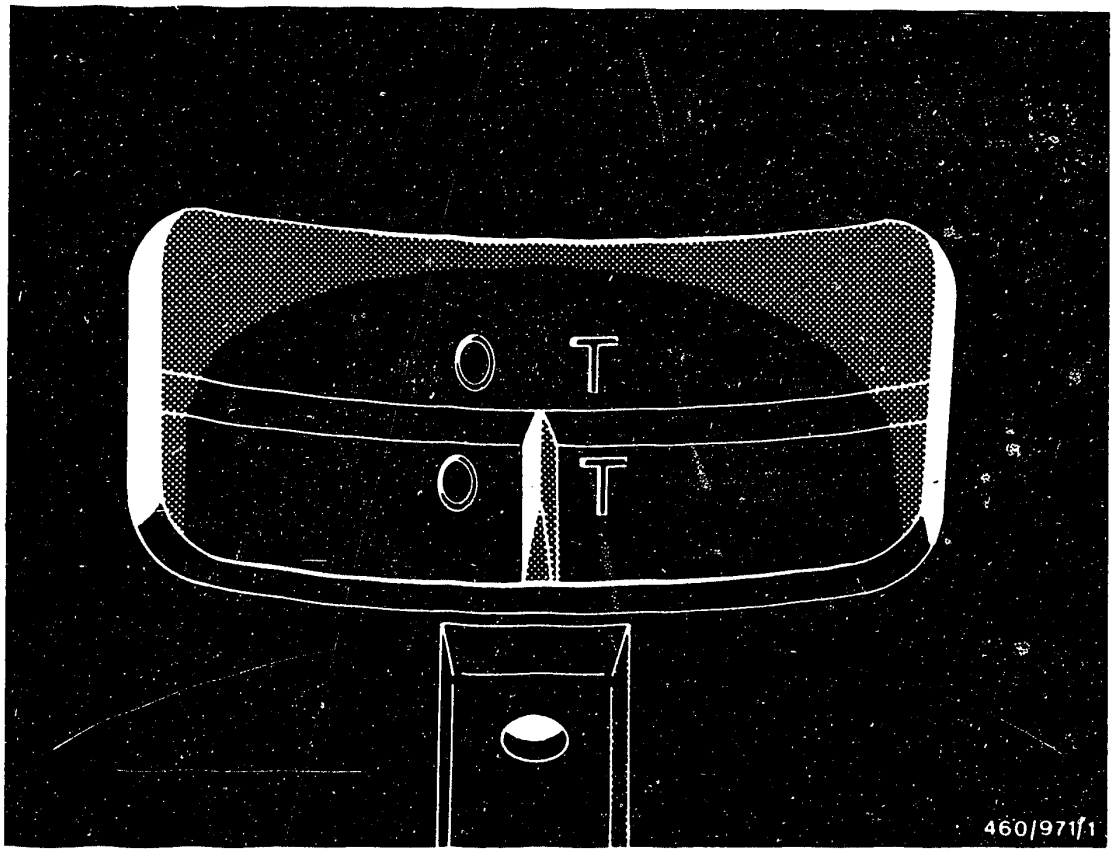
Loosen union nuts of fuel-injection tubing on nozzle-holder assemblies.

Actuate starting motor without preheating. When the fuel escaping from the bleeder hole of the injection pump is free of bubbles, tighten bleeder screw.

Continue to operate starting motor until fuel escapes from union nuts of nozzle-holder assemblies (arrows).

Tighten union nuts.

Actuate starting motor until engine starts.

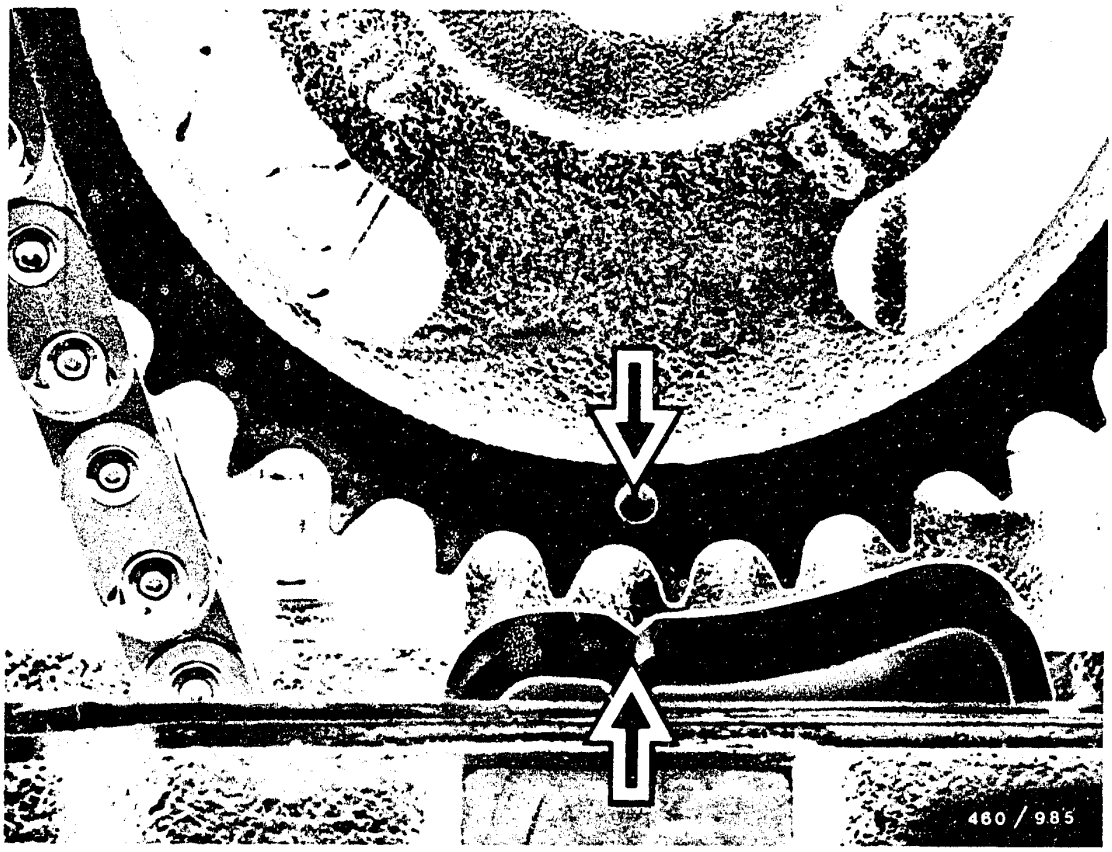


27. Check and adjust engine timing

27.1 Check engine timing

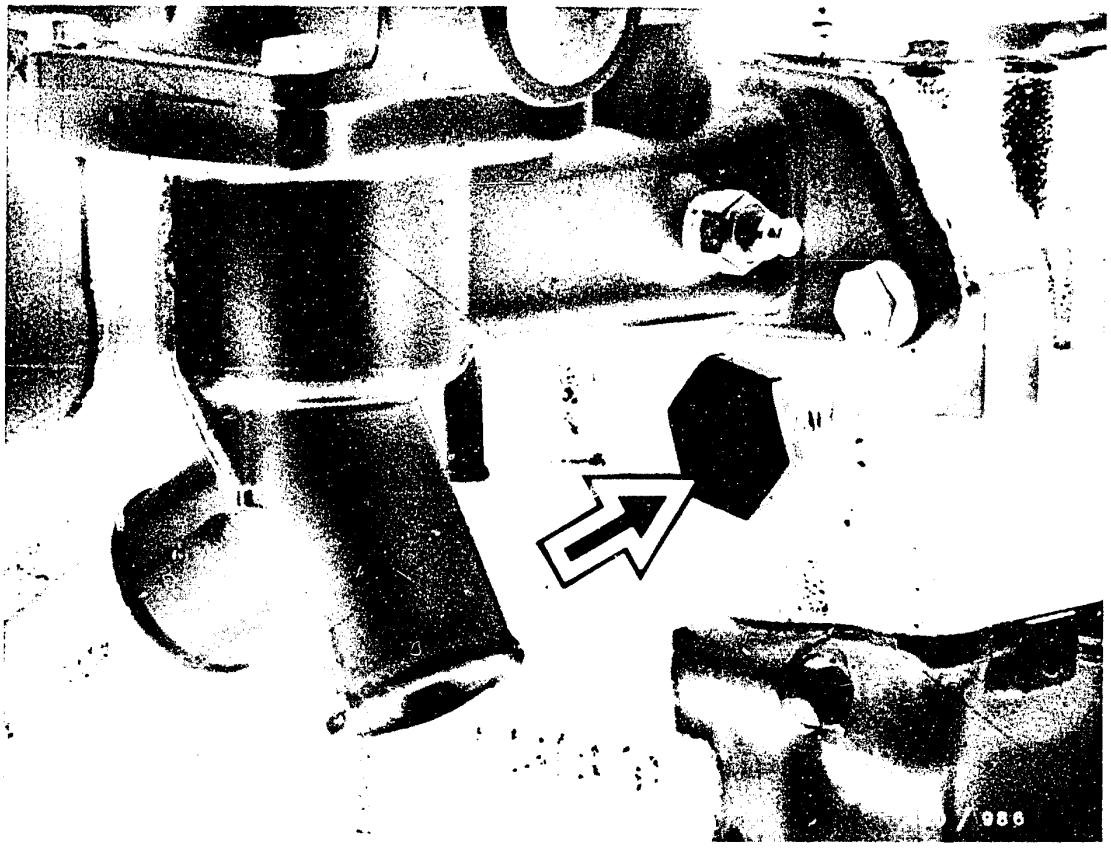
Remove cylinder head cover.

Turn crankshaft to TDC on cylinder 4 (cylinder 1 on valve overlap).



Mark on camshaft gear and reference mark on sliding rail (arrow) must be in alignment.

If these marks are not in alignment, adjust the engine timing.

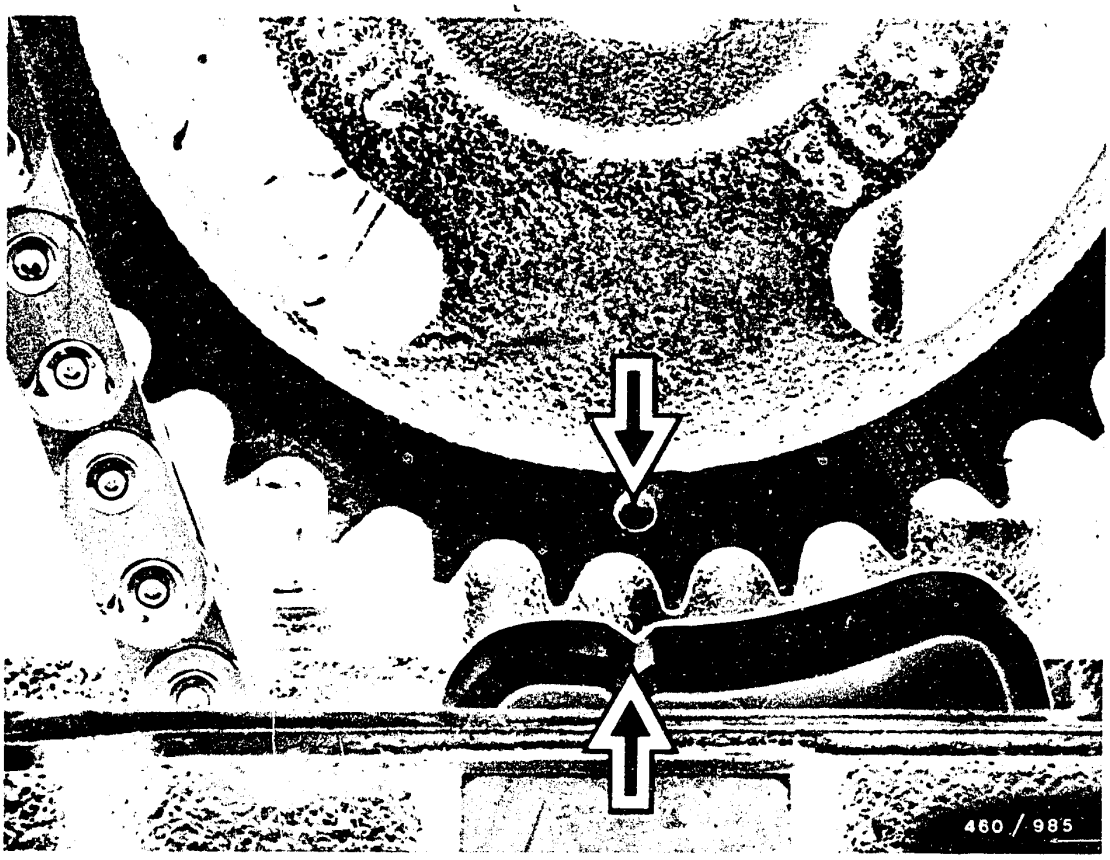


27.2 Adjust engine timing

Turn crankshaft to TDC on cylinder 4.

Loosen chain tensioner (arrow).

Lift timing chain off camshaft gear (until camshaft gear is free to rotate).



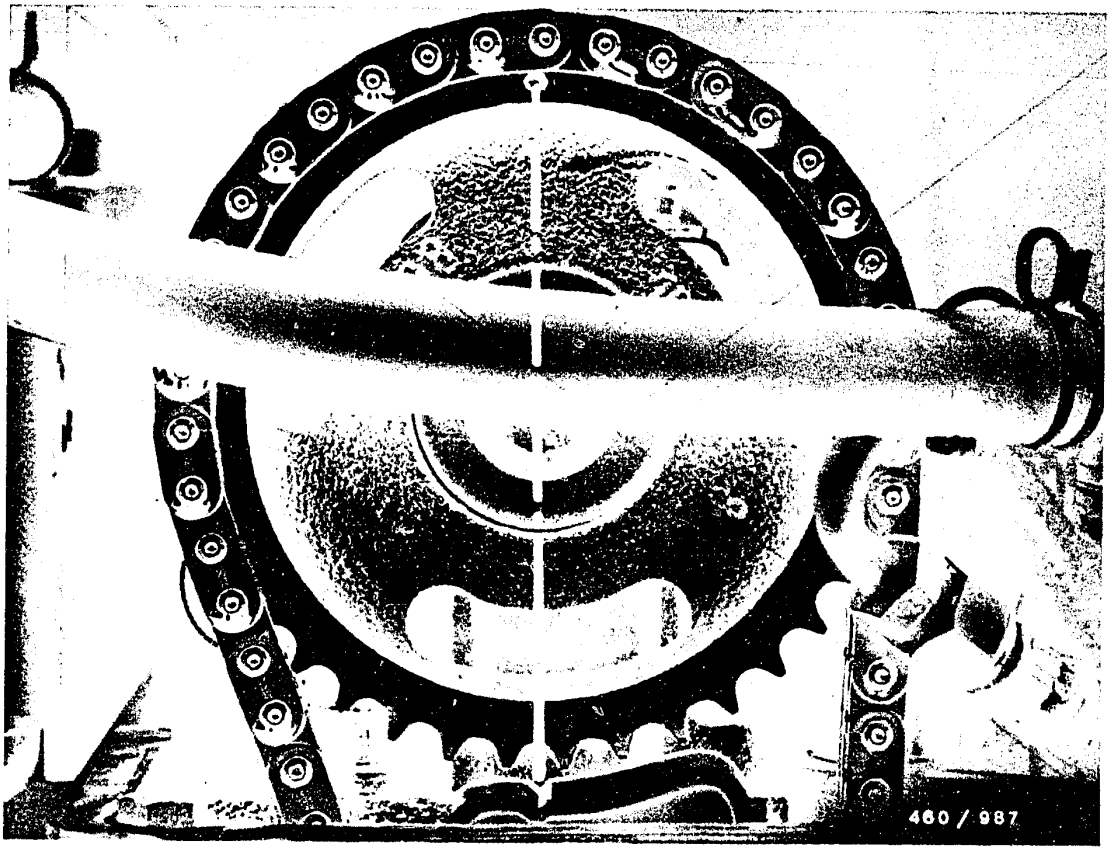
Turn camshaft under timing chain till mark on camshaft gear and reference mark on sliding rail (arrow) align.

Let down timing chain.

Screw in chain tensioner.

Turn crankshaft over twice and check engine timing once again.

Turn crankshaft to TDC on cylinder 1 (cylinder 4 on valve overlap).



Mark on camshaft gear is in alignment with reference mark on sliding rail (see picture).

Remove injection lines from injection pump and nozzle-holder assemblies (prevent delivery-valve holders from coming loose by holding with a wrench).

Remove bleeder screw from central screw plug (triangular plug) of hydraulic head.

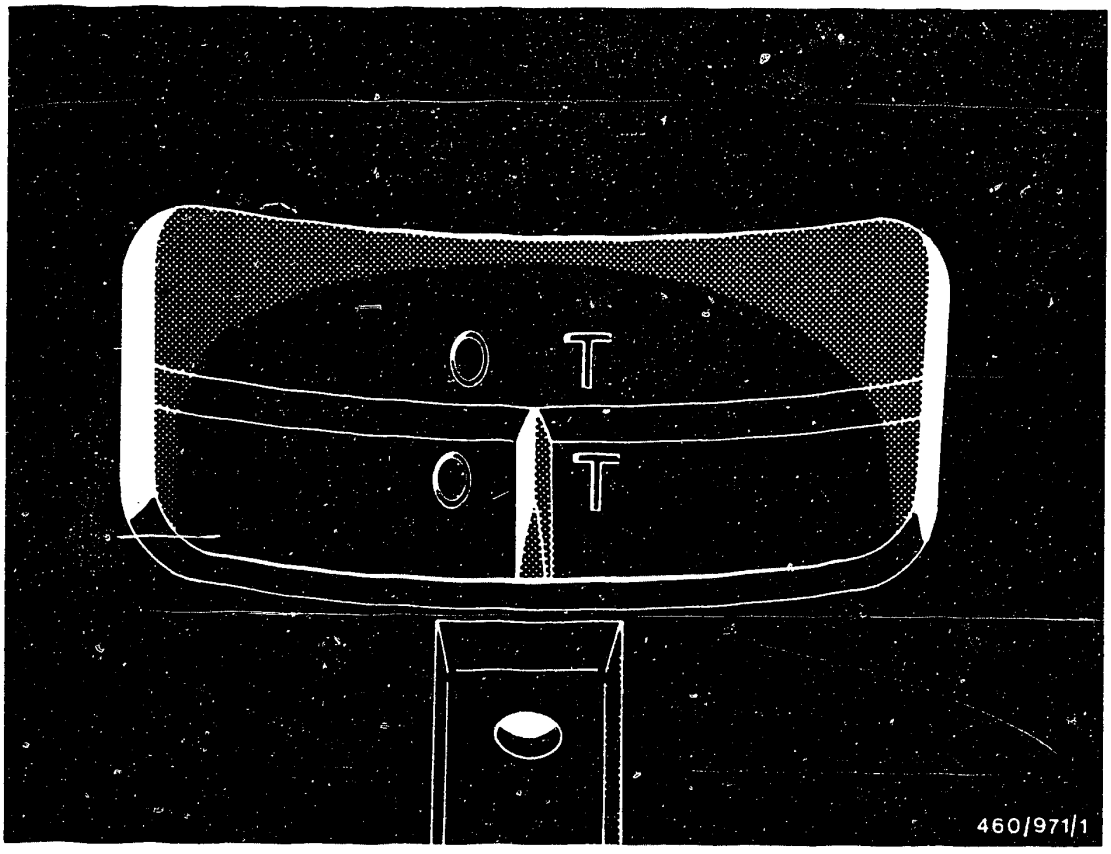
Insert measuring tool KDEP 1126 with dial indicator into tapped hole.

Preload dial indicator by approx 3 mm.

Slowly turn crankshaft against engine direction of rotation until the pointer of the dial indicator no longer moves.

Set dial indicator to "0".

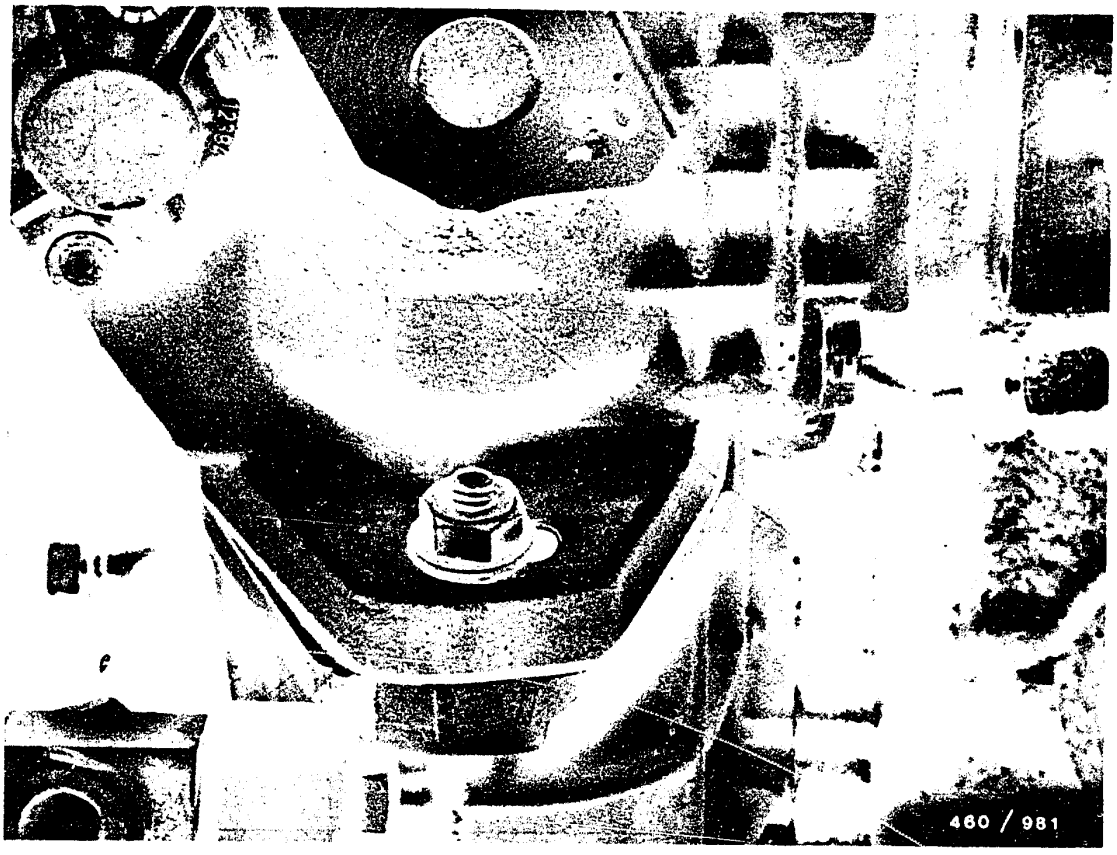
When checking and setting the start of delivery, the cold-start accelerator must be in the zero position.



Turn crankshaft in engine direction of rotation until TDC mark (OT) on flywheel aligns with reference mark on clutch housing.
If you turn past the "TDC" (OT) mark, turn back again beyond "OT" point, and then turn again to "OT".
With the piston in this position, the dial indicator on the injection pump must indicate the correct value for the engine.

2.0 D with VE..L28	1.07 ± 0.05 mm after BDC	(*1.30)
2.1 D with VE..L27	0.95 ± 0.05 mm after BDC	
2.1 D with VE..L12	0.88 ± 0.05 mm after BDC	
2.3 D with VE..L37	0.93 ± 0.05 mm after BDC	(*1.24)
2.3 D with VE..L128	0.93 ± 0.05 mm after BDC	
2.3TD with VE..L156	0.85 ± 0.05 mm after BDC	

* With modified timing-device cover



If a correction is necessary, loosen injection-pump fastening screws and set the respective stroke by pivoting.

2.0 D with VE..L28	1.07 ± 0.05 mm after BDC	(*1.30)
2.1 D with VE..L27	0.95 ± 0.05 mm after BDC	
2.1 D with VE..L12	0.88 ± 0.05 mm after BDC	
2.3 D with VE..L37	0.93 ± 0.05 mm after BDC	(*1.24)
2.3 D with VE..L128	0.93 ± 0.05 mm after BDC	
2.3TD with VE..L156	0.85 ± 0.05 mm after BDC	

* With modified timing-device cover

Checking the adjustment

Turn crankshaft back against engine direction of rotation until the pointer of the dial indicator no longer moves.

Set dial indicator to "0".

Turn crankshaft in engine direction of rotation until dial indicator indicates the setting value.

With the pump plunger in this position, TDC (OT) mark on flywheel must align with reference mark on clutch housing.

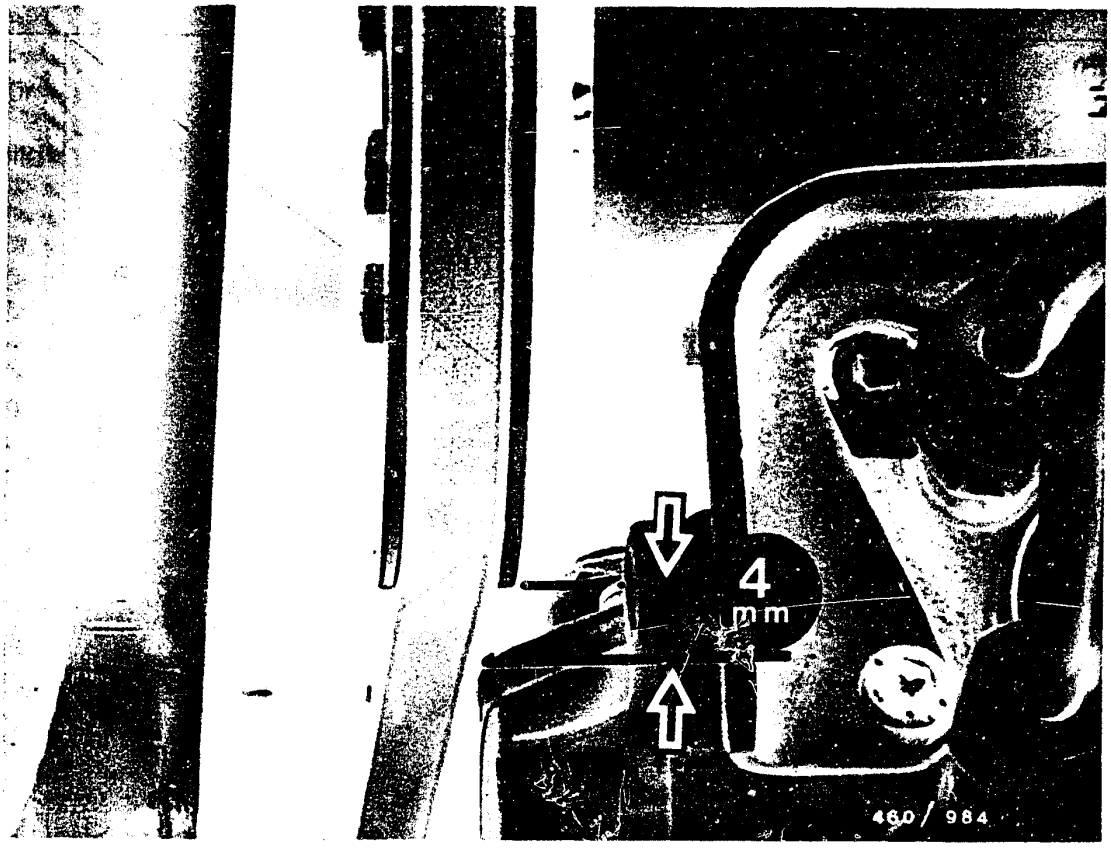
Tighten fastening nuts to 25 Nm.

Remove measuring tool KDEP 1126 with dial indicator.

Mount bleeder screw on injection pump with new seal ring.

Tighten injection lines with box wrench KDEP 1115 (prevent delivery-valve holders from turning by holding with a wrench).

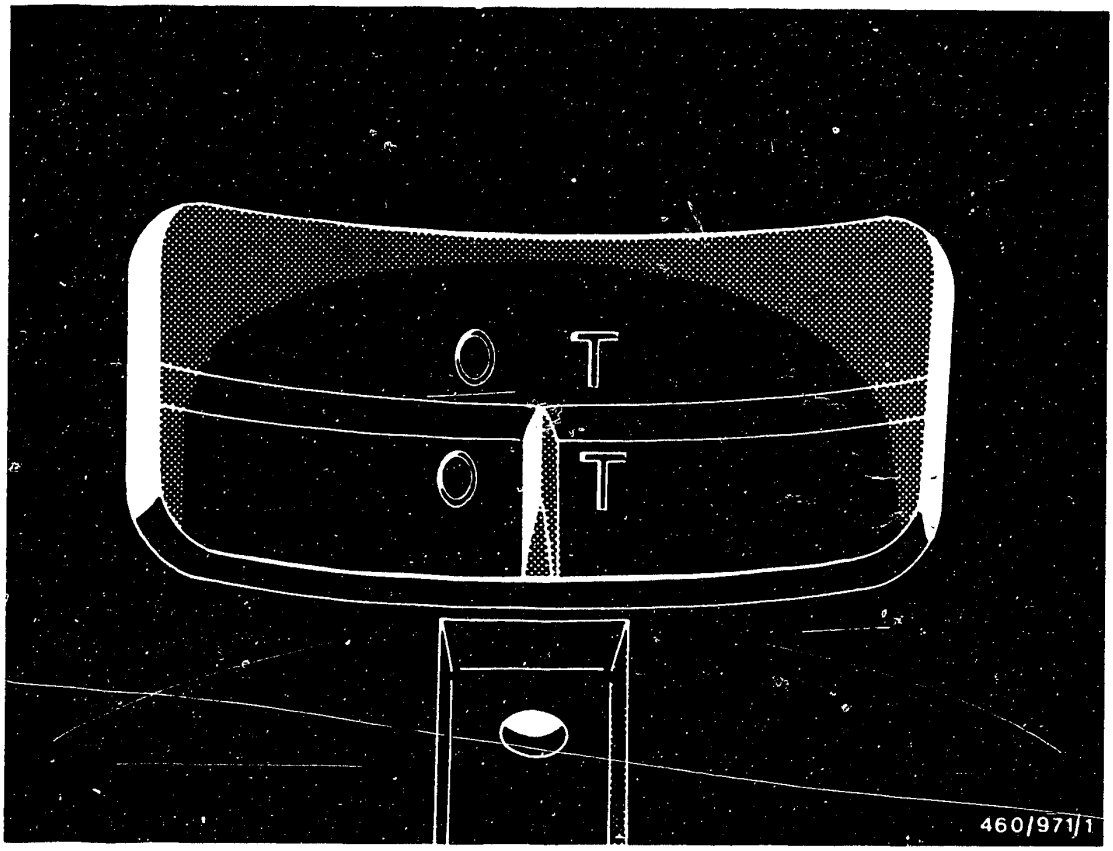
Mount cylinder head cover.



Note on installation: (does not apply to 2.3 l turbo-diesel)

After setting the start of delivery, there must be a minimum gap of 4 mm between timing-device cover and V-belt of vacuum pump.

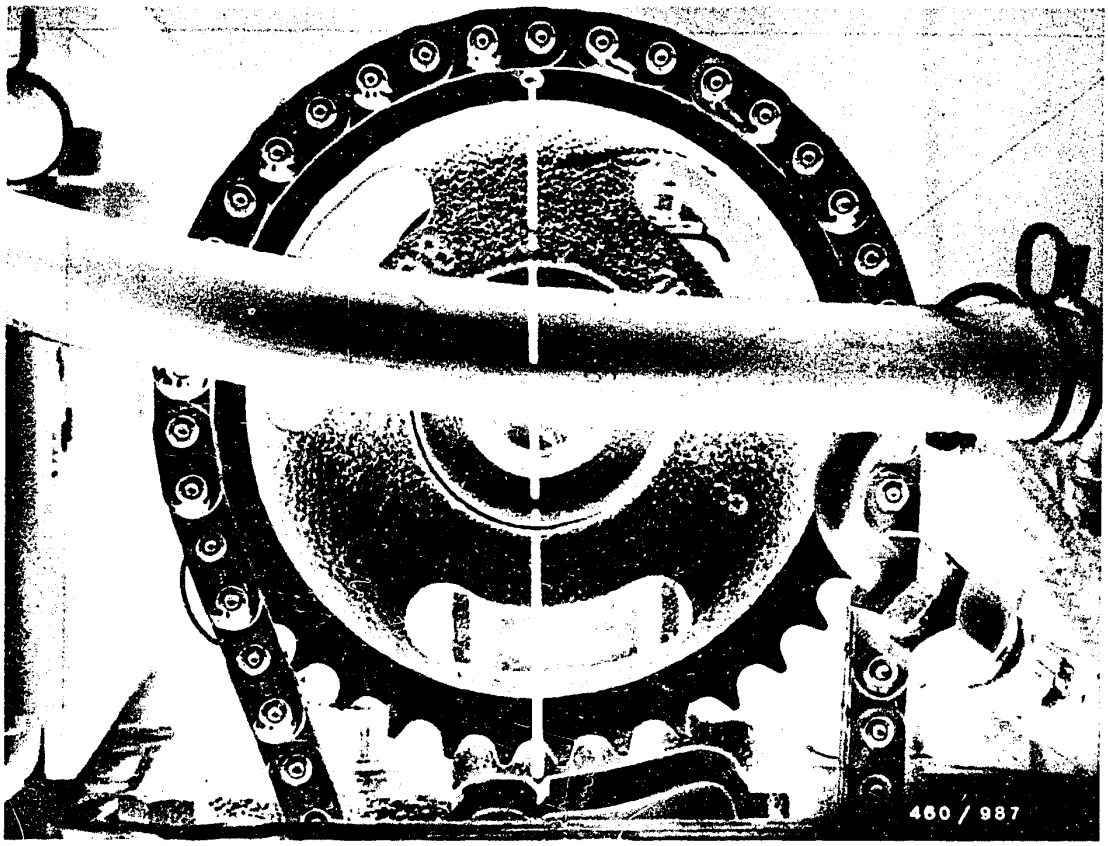
If the gap is smaller, turn crankshaft back to position "P".
Unscrew injection-pump fastening nuts and lift injection pump until drive pinion comes out of engagement.
Pivot injection pump to the left and re-insert one tooth later.
Repeat setting of start of delivery. After setting, the stay bolt should be as near as possible to the left-hand slot.



28. Injection timing

Remove cylinder head cover.

Turn crankshaft to TDC on cylinder 1 (cylinder 4 on valve overlap).



Mark on camshaft gear is in alignment with reference mark on sliding rail.

Remove injection lines from injection pump and nozzle-holder assemblies (prevent delivery-valve holders from coming loose by holding with a wrench).

Remove bleeder screw from central screw plug (triangular plug) of hydraulic head.

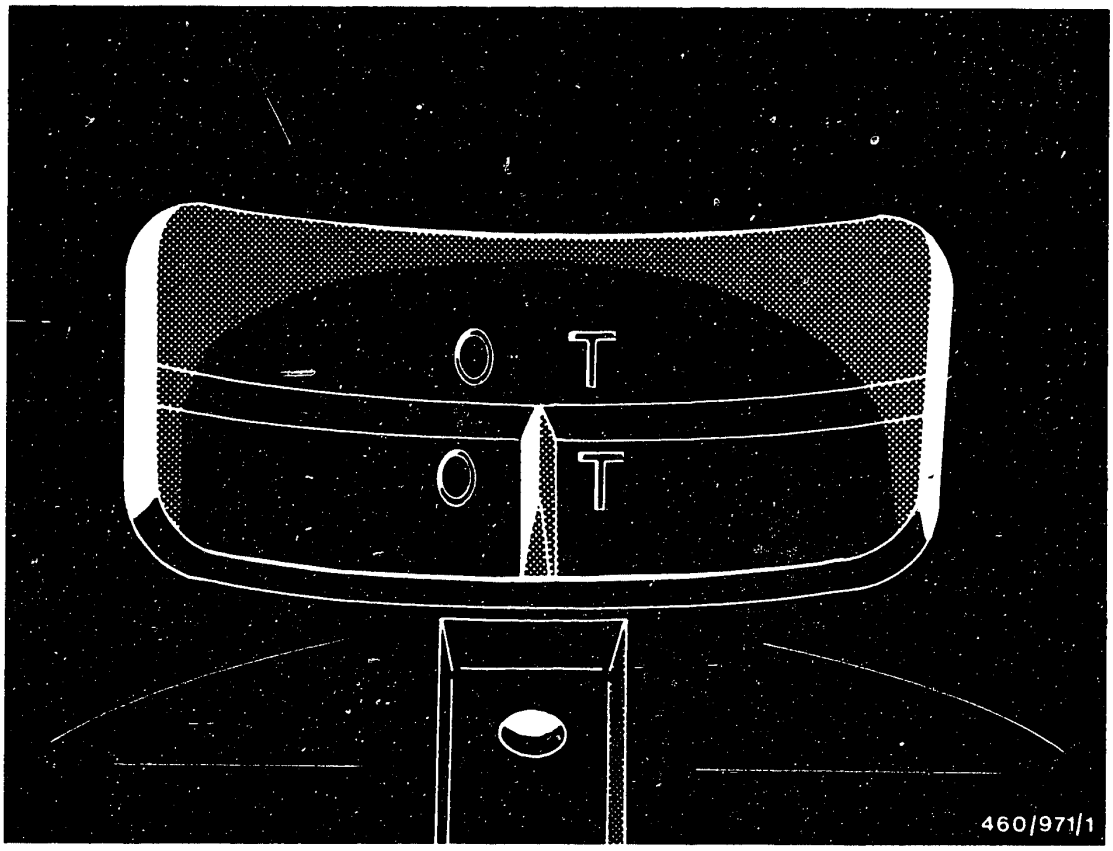
Insert measuring tool KDEP 1126 with dial indicator into tapped hole.

Preload dial indicator by approx 3 mm.

Slowly turn crankshaft against engine direction of rotation until the pointer of the dial indicator no longer moves.

Set dial indicator to "0".

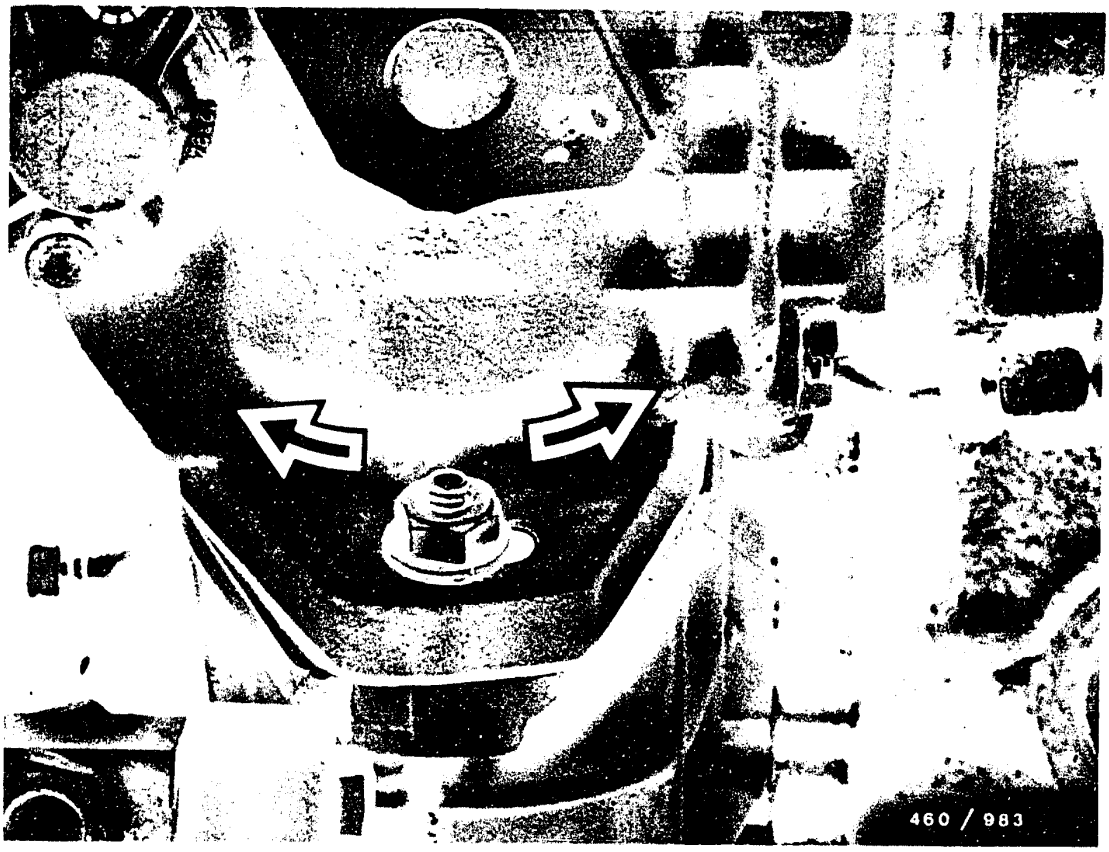
When checking and setting the start of delivery, the cold-start accelerator must be in the zero position.



Turn crankshaft in engine direction of rotation until TDC mark (OT) on flywheel aligns with reference mark on clutch housing.
If you turn past the "TDC" (OT) mark, turn back again beyond "OT" point, and then turn again to "OT".
With the piston in this position, the dial indicator on the injection pump must indicate the correct value for the engine.

2.0 D with VE..L28	1.07 ± 0.05 mm after BDC (*1.30)
2.1 D with VE..L27	0.95 ± 0.05 mm after BDC
2.1 D with VE..L12	0.88 ± 0.05 mm after BDC
2.3 D with VE..L37	0.93 ± 0.05 mm after BDC (*1.24)
2.3 D with VE..L128	0.93 ± 0.05 mm after BDC
2.3TD with VE..L156	0.85 ± 0.05 mm after BDC

* With modified timing-device cover



If a correction is necessary, loosen injection-pump fastening screws and set the respective stroke by pivoting.

2.0 D with VE..L28	1.07 ± 0.05 mm after BDC	(*1.30)
2.1 D with VE..L27	0.95 ± 0.05 mm after BDC	
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2.3 D with VE..L128	0.93 ± 0.05 mm after BDC	
2.3TD with VE..L156	0.85 ± 0.05 mm after BDC	

* With modified timing-device cover

Checking the adjustment

Turn crankshaft back against engine direction of rotation until the pointer of the dial indicator no longer moves.

Set dial indicator to "0".

Turn crankshaft in engine direction of rotation until dial indicator indicates the setting value.

With the pump plunger in this position, TDC (OT) mark on flywheel must align with reference mark on clutch housing.

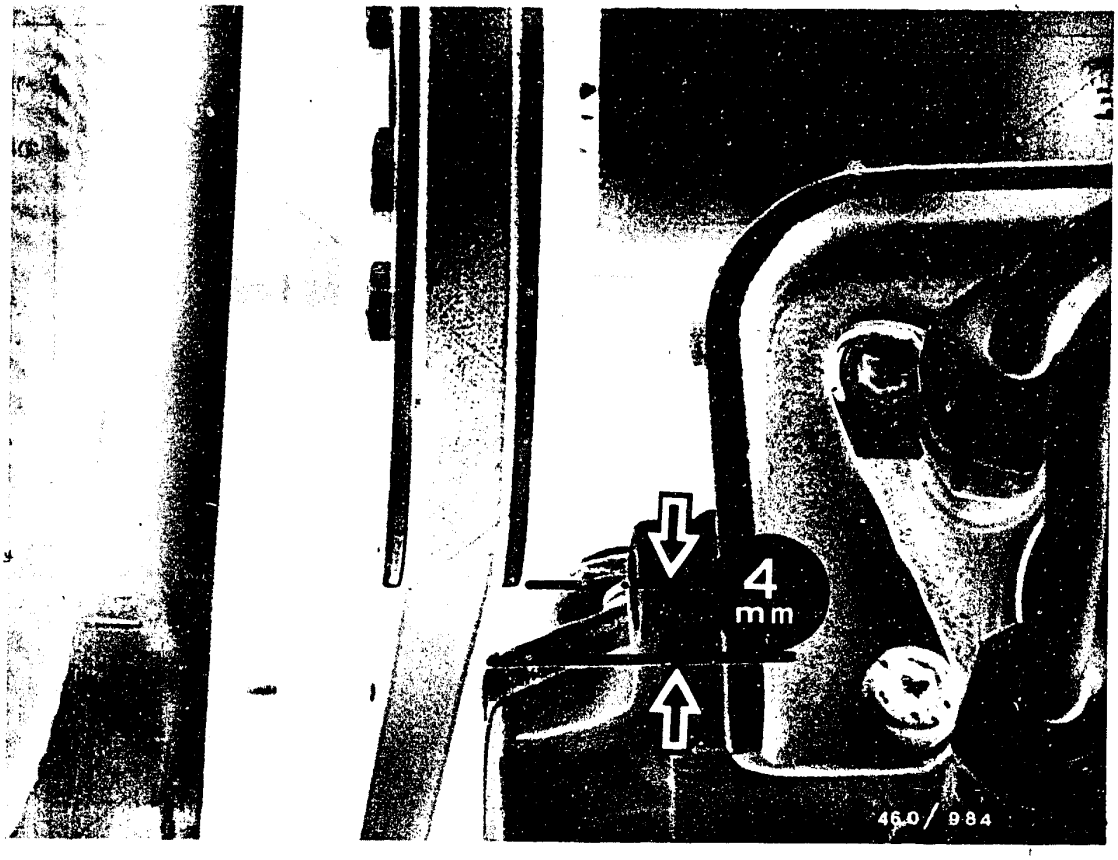
Tighten fastening nuts to 25 Nm.

Remove measuring tool KDEP 1126 with dial indicator.

Mount bleeder screw on injection pump with new seal ring.

Tighten injection lines with box wrench KDEP 1115 (prevent delivery-valve holders from turning by holding with a wrench).

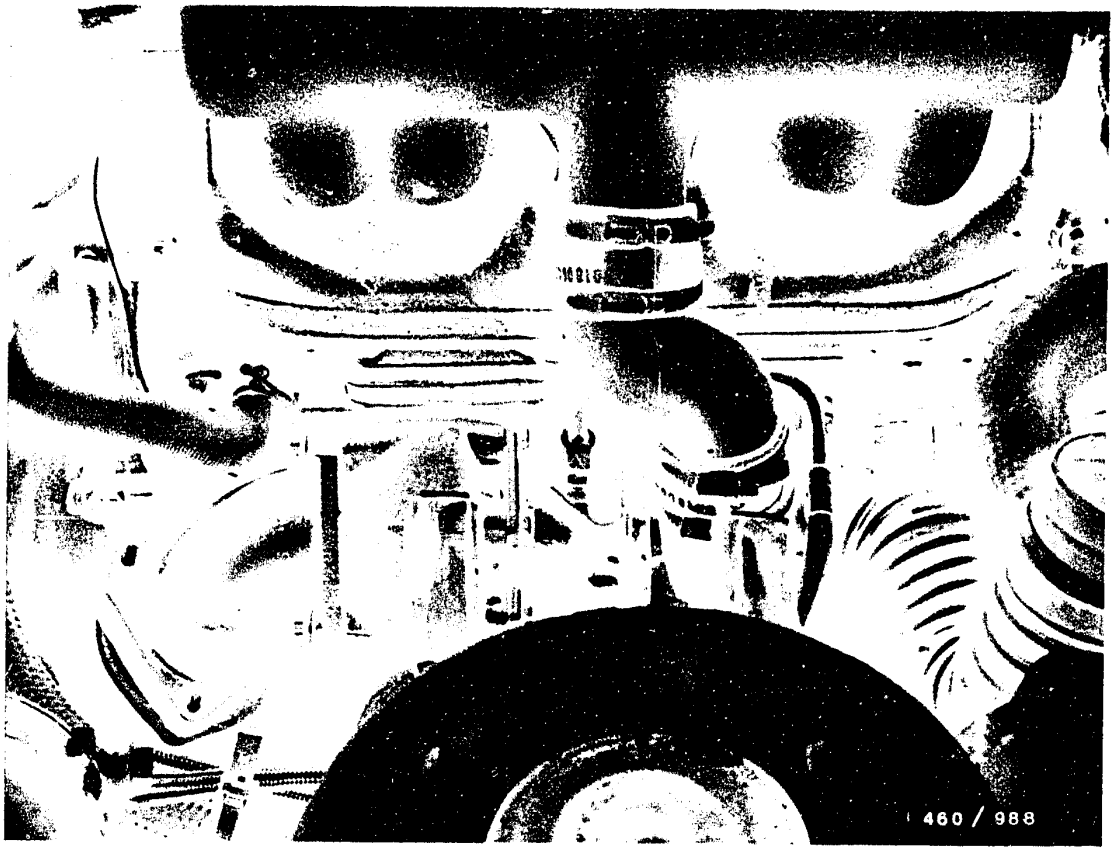
Mount cylinder head cover.



Note on installation: (does not apply to 2.3 l turbo-diesel)

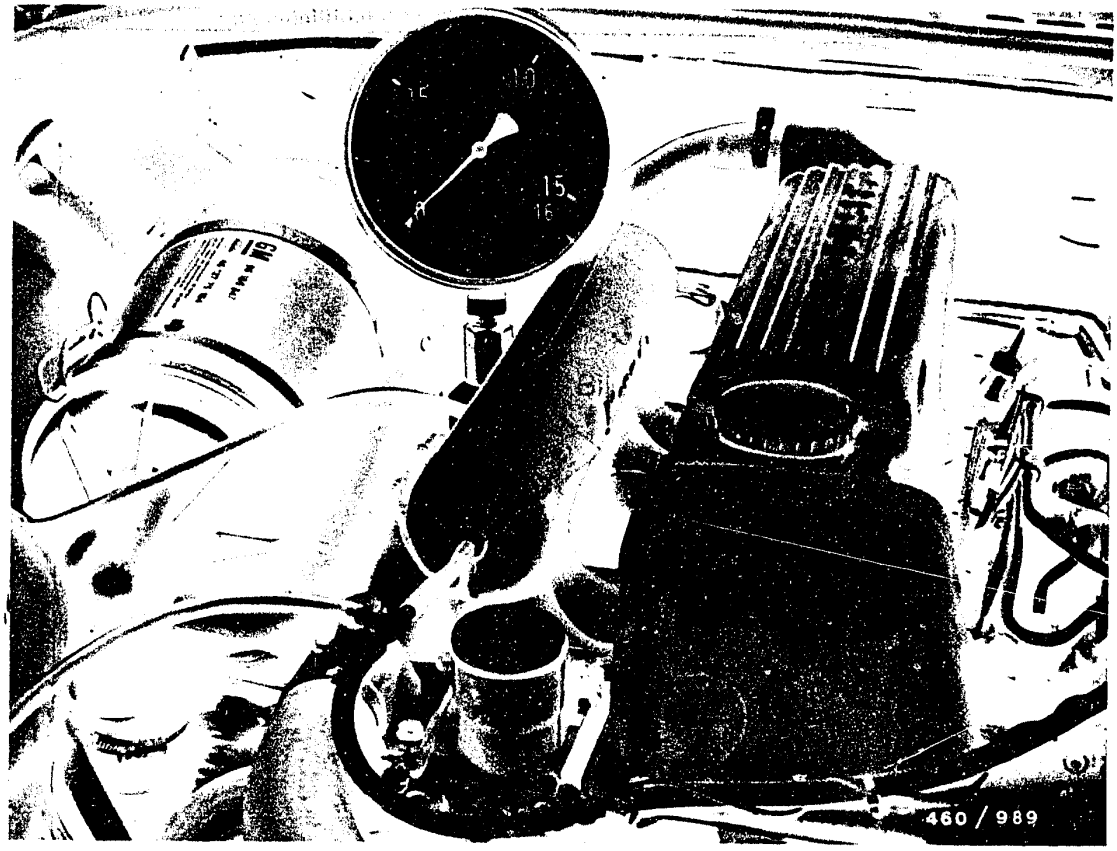
After setting the start of delivery, there must be a minimum gap of 4 mm between timing-device cover and V-belt of vacuum pump.

If the gap is smaller, turn crankshaft back to position "P".
Unscrew injection-pump fastening nuts and lift injection pump until drive pinion comes out of engagement.
Pivot injection pump to the left and re-insert one tooth later.
Repeat setting of start of delivery. After setting, the stay bolt should be as near as possible to the left-hand slot.

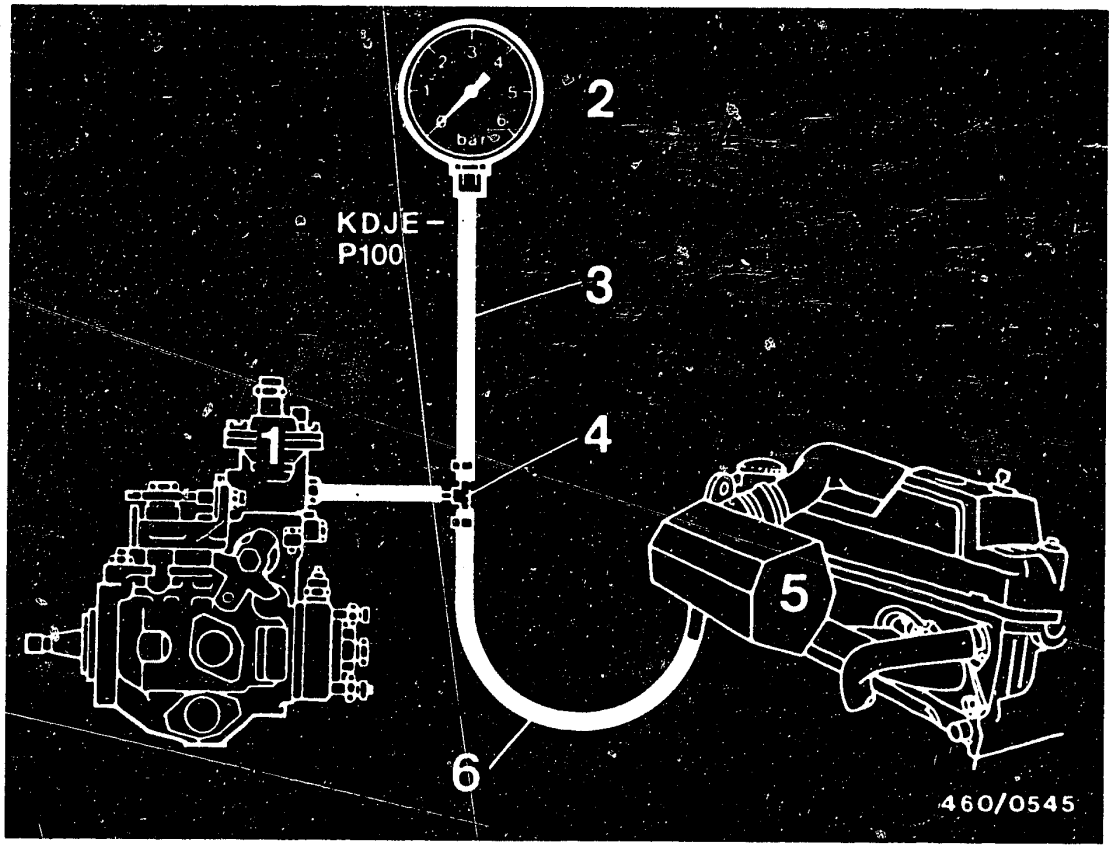


29. Test charge-air pressure

When working on the turbocharger, it should be noted that even the smallest particles of dirt can lead to the destruction of the turbocharger.
Therefore, never operate the engine without air filter.



To test the charge-air pressure, it is possible to use pressure tester KDJE-P 100, or a pressure gauge 0...1.6 bar (e.g. Wika No. 4184) (picture).



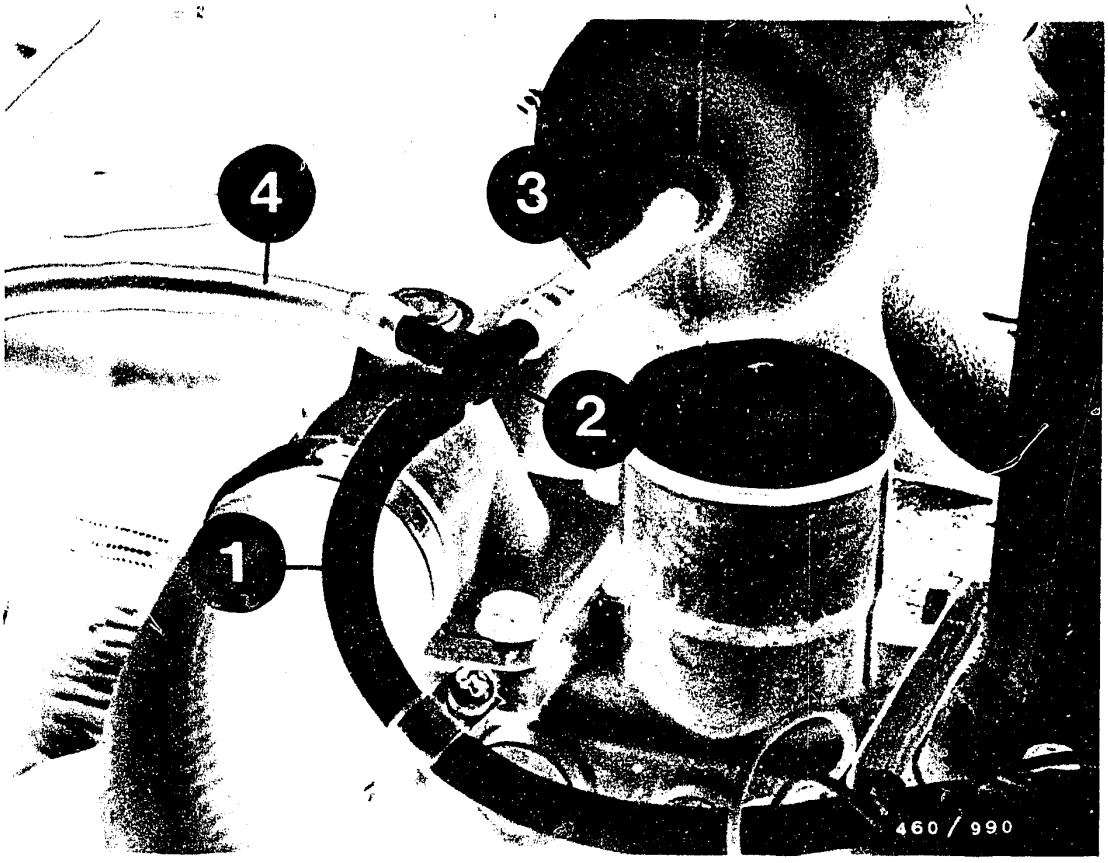
29.1.1 Mounting the pressure tester KDJE-P 100

Pull connecting hose between charge-air tube (5) and injection-pump manifold-pressure compensator (1) off the charge-air tube.

Plug on T-piece (4).

Make connection to charge-air tube using commercially available hose (6).

Connect connection hose (3) of pressure tester (2) to T-piece.



29.1.2 Mounting the pressure gauge for measuring the charge-air pressure

1 = Connecting hose
2 = T-piece
3 = Commercially available hose
4 = Connecting hose

Pull connecting hose (1) between charge-air tube and injection-pump manifold-pressure compensator off the charge-air tube (arrow).

Plug on Y-piece (2).

Make connection to charge-air tube using commercially available hose (3).

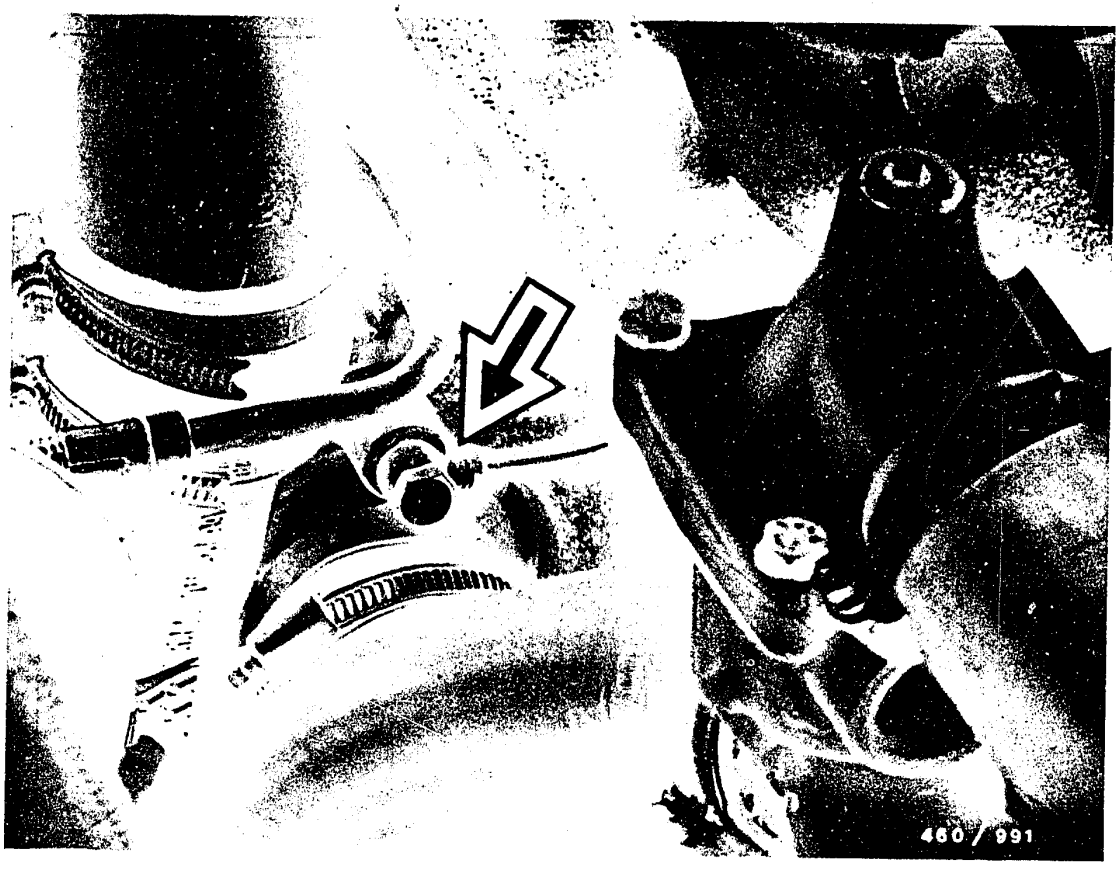
Plug connection hose of pressure gauge onto Y-piece (4).

29.2 Measuring the charge-air pressure

The charge-air pressure is measured on the chassis dynamometer from an engine speed of 1800 + 400 min^{-1} upward.

Set value: 0.75 ... 0.80 bar

Note:
To assess the turbocharger, it is essential that the start of delivery and the nozzle-opening pressure are correctly set, that the air-intake and exhaust sides have no leaks, and that the engine is in proper mechanical condition (valve clearance, compression pressure).



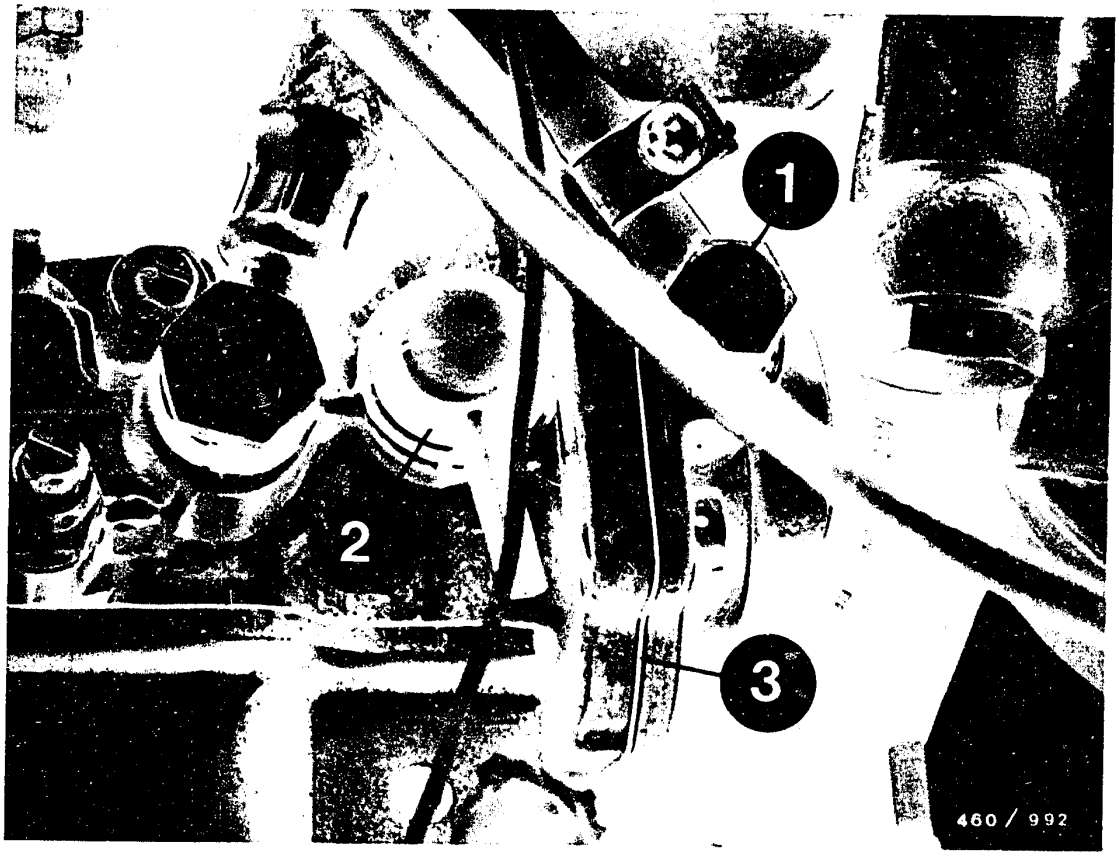
29.2.1 Charge-air pressure too high

Possible causes of charge-air pressure being too high:

- Line to charge-air pressure leaking (arrow)
- Diaphragm of wastegate defective (*).
- Valve of wastegate seized, closed (*).
- Valve of wastegate incorrectly set (*).

* = Replace exhaust-gas turbocharger.

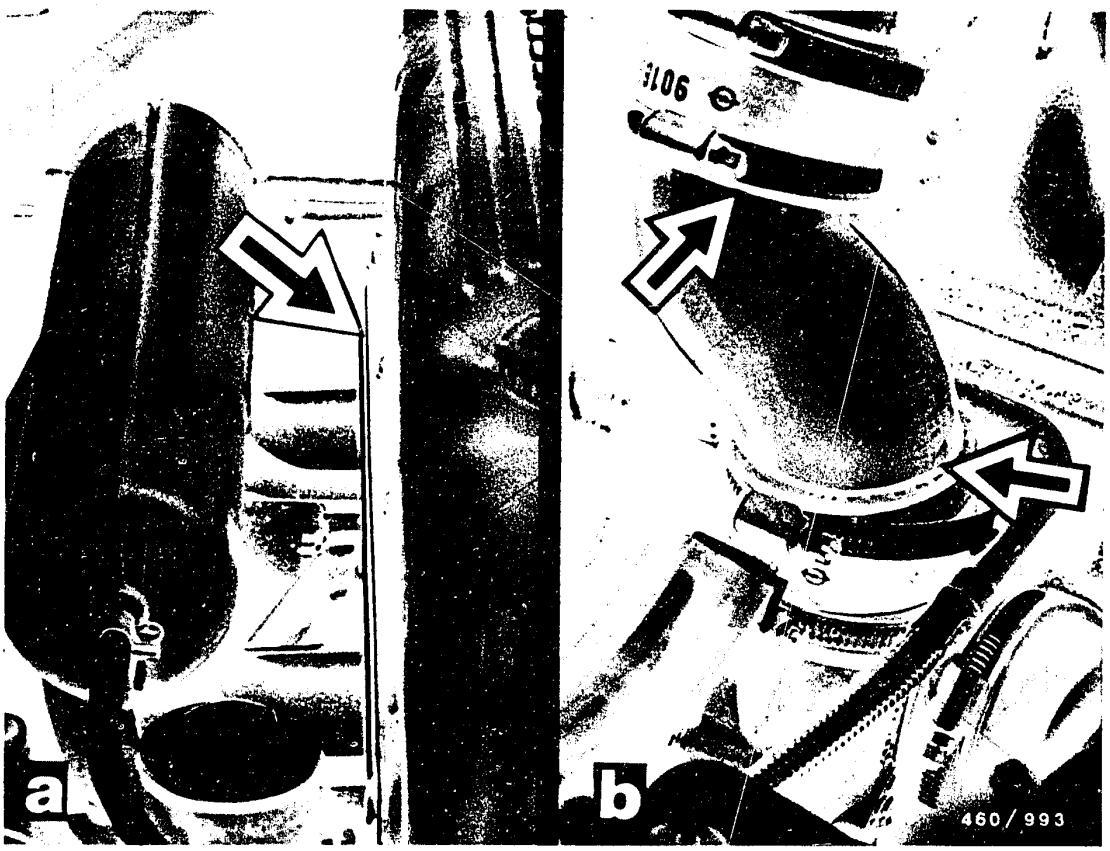
Note:
After installing a new exhaust-gas turbocharger, fill turbocharger with oil and let engine idle for approx 1 minute so that the oil supply to the turbocharger is assured.



29.2.2 Charge-air pressure too low

If the charge-air pressure is too low, check the following points for leaks:

- Connecting hose (1) between charge-air tube and manifold-pressure compensator (injection pump).
- Air line to manifold-pressure compensator (2) possibly clogged.
- Diaphragm in manifold-pressure compensator (3).



- Gasket between charge-air tube and engine block (picture a, arrow).
- Connecting hose between compressor outlet and charge-air tube (picture b, arrows).

Further causes of charge-air pressure being too low:

- Air filter (dirty)
- Wastegate incorrectly set *.
- Turbine shaft tending to seize *.
- Exhaust system clogged.

* = Replace exhaust-gas turbocharger.

Only for use within the Bosch organization. Not to be communicated to any third party

OPEL REKORD DIESEL 2.0 and 2.3 D
with VE..F.. distributor-type fuel-injection pumps L 28 and L 37

VDT-I-OPE 021 En

3.1983
(Replaces Ed. 1.1982)

Cold start difficulties

Cold start difficulties occasionally occur in the above-mentioned vehicles.

Remedy

Correct the start of injection (advanced adjustment) in the starting range by fitting a modified timing-device cover with a 2 mm collar. Conversion can be carried out without removing the fuel-injection pump.

Procedure

1. Remove the vacuum pump.

2. Check the start of delivery and correct, if necessary:

   2.0 l : start of delivery = 1.04 mm after BDC, engine TDC

   2.3 l : start of delivery = 0.93 mm after BDC, engine TDC

3. Exchange the original timing-device cover 1 461 074 302 (pressure side) for the modified timing-device cover KDEP 1129 (see drawing 1). Before fitting, this modified cover must be marked with your workshop designation.

   If the conversion is made with the pump removed, then the pump must be timed to the engine as follows:

   2.0 l : start of delivery = 1.30 mm after BDC, engine TDC

   2.3 l : start of delivery = 1.24 mm after BDC, engine TDC

   The start of delivery given above (1.30 mm and 1.24 mm) is therefore the start of delivery of the distributor-type fuel-injection pump with new timing-device cover.

   The modified timing-device cover KDEP 1129 can be ordered outside of Germany from your RG/AV.

   DM 3,50 per item - minimum purchase 10 items

The cover (see drawing 2) can be user-fabricated as follows:

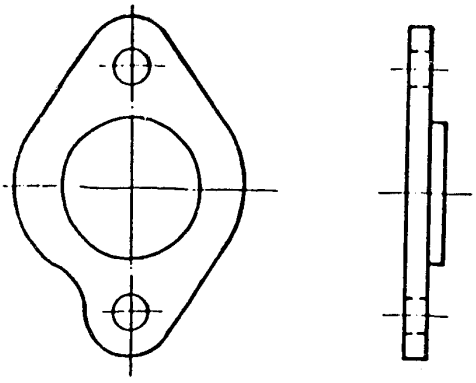
1. Drill out the center of a steel disk (dia. 22 mm x 2 mm thick) to a diameter of 6mm. Drill and countersink holes for M6 countersunk-head screws on one side.

2. Drill out the center of the original cover 1461 074 302 to a diameter of 6 mm.

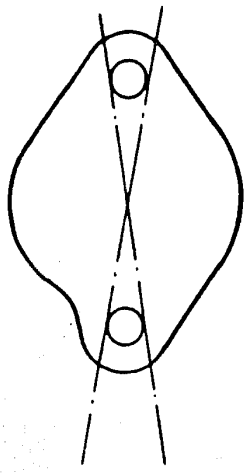
3. Attach the steel disk to the inside of the timing-device cover using suitable countersunk-head screws (M6 x 10), snap rings and nuts sealed with Loctite.

Costs

This modification is to be charged to the customer.



Drawing 1



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